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REPORT

OF THE

SECRETARY OF AGRICULTURE.

1909.

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REPORT

OF THE

SECRETARY OF AGRICULTURE.

Mr. President:

I respectfully present my Thirteenth Annual Report, covering the work of the Department of Agriculture for the year 1909.

A review of the agricultural production of 1909 is first given. Next, the results of a careful study of the prices of meat are offered, and this discussion is followed by a consideration of the extent to which the farmer has shared in the benefits of generally rising prices. The remainder of the report is taken up with an account, in greater or less detail, of the Department's work during the year.

AGRICULTURAL PRODUCTION OF 1909.

VALUE MUCH HIGHER THAN FOR ANY PREVIOUS YEAR.

MOST PROSPEROUS OF ALL YEARS.

Most prosperous of all years is the place to which 1909 is entitled in agriculture. The yield has been bountiful with most crops, and prices have been high. Advantageously situated as he is in most respects, the farmer is less and less generally compelled to dump his crops on the market at time of harvest. He does not need to work for his board and clothes, as he often did in the former time when prices were so low as to be unprofitable.

VALUE OF ALL PRODUCTS.

The value of the farm products is so incomprehensibly large that it has become merely a row of figures. For this year it is $8,760,000,000; the gain of this year over the preceding one is $869,000,000.

Ten years ago the value of the products of the farm was only five and one-half times the mere gain of this year over 1908; it was little more than one-half of the total value of this year. The value of the products has nearly doubled in ten years.

If the total value of the farm products in 1899, as established by the census, is placed at 100, the value for 1903 is represented by 125, for 1904 by 130, for 1905 by 133, for 1906 by 143, for 1907 by 159, for 1908 by 167, and for 1909 by 186.

Eleven years of agriculture, beginning with a production of $4,417,000,000 and ending with $8,760,000,000! A sum of $70,000,000,000 for the period!

It has paid off mortgages, it has established banks, it has made better homes, it has helped to make the farmer a citizen of the world, it has provided him with means for improving his soil and making it more productive.

CHIEF CROPS.

In the statement that follows concerning the crop quantities and values for 1909 no figures should be accepted as anticipating the final estimates of this Department to be made later. Only approximations can be adopted, such as could be made by any competent person outside of this Department.

CORN.

The most striking fact in the world's agriculture is the value of the corn crop of 1909 in this country. It is about $1,720,000,000.

It nearly equals the value of the clothing and personal adornments of 76,000,000 people, according to the census of 1900. The gold and silver coin and bullion of the United States are not of greater value.

This corn came up from the soil and out of the air in one hundred and twenty days—$14,000,000 a day for one crop, nearly enough for two dreadnoughts daily, for peace or war.

The value of this corn crop is the highest of record and it is greater than the average of the five preceding years by 36 per cent, while the farm price per bushel is greater by 32 per cent. The price per bushel on November 1, 62.2 cents, has been exceeded in only two years in the records of the Department of Agriculture, beginning with 1866.

In quantity of production this year's corn crop stands second, with 2,767,000,000 bushels, being exceeded by the crop of 1906, but it is greater than the average crop of the five preceding years by 3.5 per cent.

COTTON.

Cotton is now by far the second crop in value, and this year's crop is easily the most valuable one to the farmer that has been produced. With cotton lint selling at 13.7 cents at the farm November 1, and cotton seed selling for about $25 per ton, the lint and seed of this crop are worth about $850,000,000 to the farmer. No other cotton crop since 1873 has been sold by farmers for as high a price per pound as this one.

There have been three cotton crops of more than 13,500,000 bales of 500 pounds gross weight, the first one being in 1904, and commercial expectations are that the crop of this year will be below the average of the five years preceding.

WHEAT.

Third in order of value among the crops is wheat, worth about $725,000,000 at the farm, and this exceeds all previous values by a large amount. The November farm price was almost an even $1 per bushel, and its equal can not be found until as long ago as 1881. The total value of this year's crop is greater than the five-year average by 34.6 per cent.

In 1901 and in 1906 slightly larger crops of wheat were produced, so that the yield of this year, 725,000,000 bushels, is third in size.

HAY.

For years hay and wheat disputed with each other the honor of the place next after cotton in value, but this year the separation is distinct, and hay, with its value of about $665,000,000, is considerably below wheat and far below cotton. Only in one year, 1907, has its value been overtopped, and it is 10 per cent above the five-year average. The quantity of the hay crop, 64,000,000 tons, has several times been greater than it is this year, although it is now 2.6 per cent above the average of five years preceding.

OATS.

The fifth crop in order of value is oats, worth this year at the farm about $400,000,000, which is considerably above high-water mark, and is greater than the five-year average by 28 per cent. The price of November 1, 41 cents, is high, and only in 1907 and 1908 has it been higher since 1890. In production this crop is very nearly a leader, with its 984,000,000 bushels, and would have been a leader had not the crop of 1902 been about 4,000,000 bushels larger. It is greater than the five-year average by over 12 per cent.

POTATOES.

This year's crop of potatoes is more valuable than any one before produced and is worth about $212,000,000. It is above the five-year average by 25 per cent. The November price, 57.8 cents per bushel, has often been exceeded.

The large production is what makes the crop so valuable, a production that has not been equaled; it is 367,000,000 bushels, or 24 per cent above the five-year average.

TOBACCO.

Tobacco is now marketed under circumstances that secure a higher price per pound than farmers have received since 1865, except in two or three years. Since 1905 the farm price has been 10 cents or better. The farm value of this year's crop is a little under $100,000,000 and has not been equaled. It is nearly 50 per cent above the five-year average. This great value is principally due to the fact that the crop is the largest ever raised, with about 900,000,000 pounds, or one-third greater than the average of five years.

SUGAR.

It is too early to foresee the amount of the beet sugar of this year's campaign, but the indications are about 500,000 short tons, or a greater crop than any before produced. The value of the sugar and of the beet pulp for feeding purposes is about $47,000,000, an amount that has not been reached in any earlier year.

If the commercial estimate of 364,000 short tons for raw cane sugar is accepted, it is a little below the record of half a dozen years. The value of the cane sugar, molasses, and sirup is placed at $40,000,000.

With fulfillment of expectations, the entire sugar crop will be about 864,000 tons (refined beet sugar and raw cane sugar), and the value of all sugar, molasses, and sirup, from farm and factory, will reach about $95,000,000, so that for quantity of total sugar and value of total sugar, molasses, and sirup, this year is a leading one.

BARLEY.

Barley has receded from its very high price of 1907, but still has a price, 53.3 cents per bushel November 1, which has not been equaled since 1890, except in 1907 and 1908. The farm value of this year's crop is nearly $88,000,000, which has been exceeded only twice, and is 15 per cent over the average of the previous five years.

The production, 165,000,000 bushels, is third in quantity, although, compared with five years before, it is 6 per cent higher.

FLAXSEED.

The production of flaxseed seems to be declining, and the crop of this year is estimated at 25,767,000 bushels, a trifle under the five-year average. But the value of the seed per bushel, $1.398, is the highest since the Bureau of Statistics began to ascertain the farm price in 1902, and the crop is worth $36,000,000, or considerably more than ever before, and 40 per cent over the average of the previous five years.

RICE.

The estimate of rough rice production this year is a little over 1,000,000,000 pounds, an amount considerably above the highest previous crop. It is 21 per cent over the five-year average. The lead of the value is even more pronounced, since the price is high, and the total for the crop is about $25,000,000.

RYE.

Rye is a crop that remains at almost constant production, about 31,000,000 bushels, and the value this year is about $23,000,000, which has often been exceeded.

HOPS.

A shortage in the world's crop of hops this year raised the price to a high figure, about 33 cents for New York and about 24 cents for the Pacific Northwest. It happened, however, that a large proportion of the Pacific coast crop had been contracted for last year at about 9 cents, so that the average price paid for the whole crop is not as high as market prices indicate. The quantity of the hop crop this year is below the five-year average, but the value is about $8,000,000, or next to the highest year.

ALL CEREALS.

Although a bushel of oats weighs less than a bushel of other cereals, yet there is considerable significance in comparing the total quantity of all cereals in recent years. The total for 1909 is 4,711,000,000 bushels, an amount considerably greater than that for any other year except 1906, when the total was 4,872,000,000 bushels. The average of five years is exceeded in 1909 by 6.5 per cent.

The farm value of all cereals in 1909 has never been equaled in a previous year. It is almost exactly $3,000,000,000, or 34 per cent above the five-year average.

SUMMARY OF COMPARISONS.

Compared with the average of the preceding five years, every one of the crops particularized in the foregoing was larger, except cotton, flaxseed, hops, and cane sugar. Without exception every crop was worth more to the farmer than the five-year average.

This is the year of highest production for potatoes, tobacco, beet sugar, all sugar, and rice; a year of next to the highest production for corn, oats, and all cereals; the crop third in size for wheat.

For value, the amount has not been equaled in the case of corn, cotton, wheat, oats, all cereals, potatoes, beet sugar, all sugar, flaxseed, and rice; the year is next to the highest for hay, cane sugar, and hops; and the barley crop is third in value.

Compared with 1908, this year's gains in value of farm products are found all along the line, the exceptions being barley, buckwheat, rye, and milk. The increase for cotton—lint and seed—is $208,000,000; wheat, $107,000,000; corn, $105,000,000; hay, $29,000,000; oats, $22,000,000; tobacco, $18,000,000; potatoes, $15,000,000.

There were substantial gains in value of dairy and poultry products and of animals sold and slaughtered. The price of butter has not been so high in many years, and the same is true for eggs and dressed poultry, and, except for the higher price of last year, is also true for milk.

In the grand total, the farm products of 1909 are greater in value than those of 1908 by $869,000,000, or by enough to buy a new equipment of farm machinery for over 6,000,000 farms.

All cereal crops of 1909 are worth $3,000,000,000 to the farmer, an amount that would pay for all of the machinery, tools, and implements of the entire manufacturing industry in this country.

All crops are worth $5,700,000,000, which would make a half payment on the value of all steam railroads, according to the valuation of 1904. All animal products are worth over $3,000,000,000.

The total of all items is $8,760,000,000. In eleven years of application of mind, muscle, and machine to this basic industry of mankind, the wealth produced by farmers, estimated as previously described, is valued at $70,000,000,000.

FOREIGN TRADE IN AGRICULTURAL PRODUCTS.

The value of the agricultural exports of domestic products for the year ending June 30, 1909, has been exceeded in four years—in 1901, 1906, 1907, and 1908. The value for 1909 is $903,000,000, or $151,000,000 below the highest record in 1907, and $114,000,000 below the next highest in 1908.

Compared with 1908, the prominent decreases were $11,500,000 for live animals, $26,000,000 for packing-house products, $20,000,000 for cotton, $55,000,000 for grain and grain products, and $3,800,000 for tobacco. On the other hand, there was an increase of over $7,000,000 in exports of oil cake, oil-cake meal, and vegetable oils.

The domestic exports of beef and beef products declined from 579,000,000 pounds in 1908 to 419.000.000 pounds in 1909; of pork and pork products, from 1,237,000,000 to 1.053,000,000 pounds; of wheat, from 100,000,000 to 67,000,000 bushels; of wheat flour, from

14,000,000 to 10,500,000 barrels; of wheat and wheat flour in terms of wheat, from 163,000,000 bushels in 1908 to 114,000,000 bushels in 1909.

The imports of agricultural products were never so high in value as they were in 1909, the amount being $637,000,000. Principal gains were $15,000,000 in silk, $21,500,000 in wool, $25,600,000 in packing-house products, mostly hides, $11,400,000 in coffee, and $16,500,000 in sugar.

After allowing for the $10,000,000 in exports of foreign origin, the net balance of foreign trade in agricultural products in favor of this country is $256,000,000, the lowest amount since 1896. This was more because of increased imports than of decreased domestic exports. The balance of trade in favor of this country in products other than agricultural for 1909 is $46,000,000.

In foreign trade in forest products the exports of domestic origin were valued at $72,000,000, an amount that has been exceeded in only three years; compared with 1908, there was a loss in all prominent items. The imports of forest products had a value of $124,000,000 and were never before so large in value. India rubber gained $25,000,000, compared with 1908. With respect to the balance of trade in forest products, it was against this country by about $47,000,000.

The agricultural production of 1909 must add much to the prosperity of farmers. The record is unexampled in wealth produced and tells of abundance in quantity. Year by year the farmer is better and better prepared to provide the capital and make the expenditures needed to improve his agriculture and to educate his children for farm life and work.

PRICES OF MEAT.

INCREASE OF RETAIL PRICE OVER WHOLESALE.

SPECIAL INVESTIGATION.

High prices of fresh meats and of their products are of such concern to nearly every family that an examination of the subject is timely. With over two-fifths of the expenditures of the families of medium income devoted to food and with one-third of the national dietary composed of meat, the present situation is felt by the incomes of 19,000,000 families.

The higher prices of meat in recent years do not bear the less heavily on the consumer because its purveyors at various points along the line of distribution may not have raised the price in a larger degree than the price of the animal has increased. There may be too large a net profit or gross profit, or the distributive processes may be too costly at some point. Little definite information has heretofore been extracted from the retail meat business concerning its cheapness or costliness in comparison with the amount of business done, and an acquaintance with the facts has become desirable.

Through employees of the Bureau of Animal Industry inquiries were made in 50 cities—large, medium, and small—in all parts of the country. A schedule was provided to record the actual experience of retailers in buying and selling the carcass or half carcass of beef. Among the facts ascertained were the weight and wholesale cost of a certain piece of beef, usually a half carcass. Then followed the weight and retail price of every cut for which a uniform price was charged by the dealer. Thus it became possible not only to compare high and low priced cuts, from the point of view of expense to consumer, but also to compute accurately the total retail price per pound and the total retail cost of the beef piece for which the wholesale price per pound and the total wholesale cost had been reported.

FACTS DISCOVERED IN FIFTY CITIES.

In the North Atlantic States the retail price of beef is 31.4 per cent higher than the wholesale price; and the percentage is usually lower in the larger cities than in the smaller ones, and higher in the case of beef that is cheap at wholesale than of high-priced beef.

In Allentown, Pa., there is an immediate gross profit of 50 per cent—that is, the total amount charged at retail is 50 per cent above the wholesale cost. Such gross profits are noticed for the smaller places as 46 per cent for Canajoharie, N. Y.; 50 per cent for Cortland, N. Y.; 47 per cent for Holyoke, Mass., and for Harrisburg, Pa. But for Olean, N. Y., the percentage is only 23 and for Springfield, Mass., 19, the low price being in strong contrast with the 47 per cent for Holyoke, its near neighbor, with a different sort of inhabitants.

A gross profit of 20 per cent was found in New York, N. Y., and Philadelphia, Pa.; 28 per cent in Buffalo, N. Y., and 36 per cent in Boston, Mass.

Everywhere appears the general fact that the lower the grade of beef the greater the percentage of gross profit. Allentown's high percentage is based on wholesale prices of 7½ and 8½ cents. In Boston the rate of gross profit is twice as great for 8-cent beef as for beef costing 11 and 11½ cents. Indeed, the rule is quite general that low-priced beef is marked up twice as much relatively as high-priced beef is. In other words, perhaps it is a safe inference that the poorer people pay nearly twice the gross profit that the more well-to-do people pay.

Baltimore, Md., in the South Atlantic States, is another large city with a low rate of gross profit, 17 per cent; but Washington, D. C., has a much higher rate, 42 per cent, and Takoma Park, D. C., 44 per cent. Richmond, Va., has the low rate of 21 per cent, and Augusta, Ga., the high one of 61 per cent. The amount for the South Atlantic States is 38 per cent.

In the North Central States the mean is 38 per cent, and the foregoing observations apply concerning the higher rate of gross profit for cheap beef. The Chicago, Ill., returns are for cheap beef, and the gross retail profit is 46 per cent, but in Cincinnati, Ohio, it is only 25 per cent; Omaha, Nebr., 23 per cent; South Omaha, Nebr., 25 per cent. Kansas City, Kans., has a cheap-beef gross profit of 50 per cent, while Kansas City, Mo., reports only 28 per cent.

For the twin cities, Minneapolis and St. Paul, Minn., the gross profit is reported at 27 and 35 per cent, respectively; for Detroit, Mich., and Milwaukee, Wis., 40 per cent; and for St. Louis, Mo., 39 per cent. In the smaller places the rates of gross profit in selling beef are 52 per cent for Alton, Ill.; 53 per cent for Cedar Rapids, Iowa; 43 per cent for East Liverpool, Ohio; 31 per cent for Port Huron, Mich.; 49 per cent for Wichita, Kans.; and 27 per cent for Winona, Minn.

No other division of States stands as high in gross profit as the South Central States, with 54 per cent. The places with rates above this mean are Fort Smith, Ark., 57 per cent; Mobile, Ala., 64 per cent; Nashville, Tenn., 63 per cent; Natchez, Miss., 56 per cent; and Shreveport, La., 68 per cent. On the other hand, Fort Worth, Tex., reports only 38 per cent; Louisville, Ky., 52 per cent; and Memphis, Tenn., 32 per cent.

The mean of 39.4 per cent of gross profit is derived from reports from the Western States. The highest rate is 62 per cent for Lewiston, Idaho; next, is 58 per cent for Spokane, Wash.; 50 per cent for Ogden, Utah; 39 per cent for San Francisco, Cal., and Cheyenne, Wyo.; 37 per cent for Denver, Colo.; 24 per cent for Seattle, Wash.; and 16 per cent for Tacoma, Wash.

For the 50 cities throughout the United States for which reports were received, the mean gross profit in selling beef, that is, the total retail cost charged to consumers above the wholesale cost paid by the retailers, is 38 per cent. In 5 cities the rate of increase is 20 per cent or under; in 10 cities, 21 to 30 per cent; in 12 cities, 31 to 40 per cent; in 12 cities, 41 to 50 per cent; and in 11 cities over 50 per cent.

RETAIL COSTS.

There are some services connected with a retail meat or meat and grocery business in a city that customers desire for their accommodation which are costly to them. They want delivery of goods, perhaps by special trip, and this requires at least one man, horse, and wagon. They want the market man also to send a man to their dwellings to take orders.

Much more productive of costliness to the retail distribution of meat is the overdoing of the retail business. The multiplication of small shops is a burden to consumers and no source of riches to the small shopkeepers. When twenty or more small shops divide the retail business within the area that could be served by one large shop, the expenses of the many shops for labor, horses, rent, and other things that are in excess of what would be sufficient for the one shop must go into the retail prices of the meat sold.

Furthermore, customers are disposed to focus their choice of cuts on certain ones, and these naturally bear the higher prices. If the porterhouse steak is really beyond the cash or credit of the customer, then a sirloin must be had, and a rib roast instead of another cut for roasting. Steaks and roasts are the preferences of beef customers, and the steaks and roasts must have names that are regarded as respectable. Consequently one-fifth of the carcass is bought at the highest prices—porterhouse steak at 25 to 30 cents a pound, sirloin at 20 to 25 cents, and rib roasts at 20 cents—these being some of the prices noted in the returns received from the 50 cities.

CONDITIONS AFFECTING MEAT SUPPLY.

PER CAPITA CONSUMPTION.

Among the peoples of the earth, except those of Australasia, the inhabitants of the United States are the most liberal meat eaters. Investigations made by this Department have disclosed the fact that the per capita consumption of meat in this country, in terms of "dressed" meat, was 185.8 pounds in 1900. If the edible parts outside of that description are included, such as heart, liver, tongue, and so on, the consumption was 220.5 pounds. If all this is reduced to strictly edible meat by exclusion of bones and other nonedible parts, the per capita meat consumption of men, women, children, and babies—that is, the average for all inhabitants—was 182.6 pounds in 1900.

The meat consumption of other countries is usually stated in terms of "dressed" meat, but may include some extraneous parts. As compared with 185.8 pounds of dressed weight of meat, standing as the per capita consumption of the United States, Cuba follows next in order with 124 pounds; the United Kingdom, 121.3 pounds; Germany, 115.94 pounds; France, 78.9 pounds; Denmark, 76 pounds; Belgium, 70 pounds; Sweden, 62 pounds. The average for Australia is apparently 262.6 pounds, and for New Zealand, 212.5 pounds.

The average meat consumption of the United States has long been declining. Primarily, the supply of meat in relation to population has declined since the first live-stock census in 1840. For cattle in that year, excluding calves, there was an average of 0.88 of an animal on farms to each inhabitant, 0.81 of an animal in 1860, 0.79 of an animal in 1880, 0.92 of an animal in 1890, and 0.69 of an animal in 1900. To a considerable extent, at least, range cattle are included. Since 1900, cattle have probably hardly increased absolutely, while population has gained nearly 20 per cent.

The comparison of sheep, excluding lambs, with population, shows that there were 1.13 animals on farms in 1840 to each inhabitant, 0.71 of an animal in 1860, 0.84 of an animal in 1880, 0.65 of an animal in 1890, and 0.52 of an animal in 1900. Range sheep are supposed to be included.

The decline for swine is about as great as that for sheep, and has been uninterrupted. The ratio of swine on farms to population in 1840 was 1.54 animals; in 1860 it was 1.07 animals; in 1880 it was 0.99 of an animal; in 1890 it was 0.92 of an animal; and in 1900 it was 0.83 of an animal.

MEAT EXPORTS.

In the meantime all of the meat produced in this country has not been eaten here. Prodigious exports have gone to all the countries of the globe. The exports of cattle for slaughter rose to 593,000 in 1904, since which time there has been a decline to 208,000 in 1909.

Most of the exports of meat and its products are stated in pounds in the foreign trade reports, and, as far as so stated, the exports of beef and beef products averaged 32,000,000 pounds yearly for 1851–1855, 109,000,000 pounds for 1871–1875, 234,000,000 pounds for 1881–1885, 340,000,000 pounds for 1886–1890, 521,000,000 pounds for 1891–

1895, 601,000,000 pounds for 1896–1900, 617,000,000 pounds for 1901–1905, 733,000,000 pounds for 1906, 690,000,000 pounds for 1907, 579,000,000 pounds for 1908, and 419,000,000 pounds for 1909.

The high-water mark of beef exports was in 1906, since which year the decline has been so sharp that the exports of 1909 were only 57 per cent of those of 1906. Notwithstanding industrial depression abroad, evidently this indicated a decline in the supply of beef animals during the last three years relative to consumption in this country, especially since there has been no increased severity in the restrictions of European countries against the importation of beef. The significance of the foregoing is strengthened by the declining exports of beef cattle since 1904.

Pork and its products have far exceeded beef in exports. As far as stated in pounds—and little is omitted—the exports of pork and pork products averaged 91,000,000 pounds yearly in 1851–1855; 496,000,000 pounds in 1871–1875; 826,000,000 pounds in 1881–1885; 1,061,000,000 pounds in 1891–1895; 1,462,000,000 pounds in 1896–1900; 1,242,000,000 pounds in 1901–1905; 1,465,000,000 pounds in 1906; 1,268,000,000 pounds in 1907; 1,237,000,000 pounds in 1908; and for 1909 was 1,053,000,000 pounds.

In less degree than beef, pork exports indicate relatively, if not absolutely, a decline in the national supply in the last three years. While the ratio of meat animals to population has been declining during the last seventy years, exports of meat have grown to the unexampled total of 2,198,000,000 pounds of beef and pork and their products in 1906, and 593,000 beef cattle in 1904. The cattle exports fell to 208,000 animals in 1909 and the combined beef and pork exports fell to 1,472,000,000 pounds, or about 67 per cent of the high-water mark of three years before.

CHANGE IN DIETARY.

For two reasons the consumption of meat has declined in this country. The stock of meat animals has not been maintained in relation to population, and exports have increased to enormous proportions in a movement which culminated in 1906, to be followed by a sharp decline.

Seventy years ago the per capita consumption of meat was about one-half of the national dietary; in 1900 it had declined to about one-third or a little more; it may now be less than one-third.

If the entire stock of cattle, sheep, and swine are computed into meat pounds for the census years and the exports for those years are deducted, the remaining pounds may be regarded as the stock for national meat supply. Let per capita ratios be computed and let the ratio for 1840 be regarded as 100; then, by 1860, the per capita stock of meat animals declined to 82.5, by 1880 to 72.4, by 1890 to 79.4, and by 1900 to 59.3. In seventy years the per capita stock of animals for the national consumption of meat has declined to less than three-fifths of its former proportions.

It may not be that the people have unwillingly adopted a diminishing meat consumption. The diversification of agriculture and the abundant products of the farm must have had their effects on food habits. Vegetables that are locally out of season are brought from places as far away as 3,000 miles; and so with fruits, and in less degree with berries. The luxuries of former boyhood have become common foods of the present. The canning factory places the vegetable garden, the fruit orchard, and the berry field at the door of every household in the land during every day in the year. There are refrigerator cars for long-distance transportation and warehouses for cold storage. Eggs, dressed poultry, and butter are carried forward from a period of natural oversupply to a period of natural scarcity.

There is general agreement that wheat consumption for food has increased from about 4⅔ bushels to 5½ bushels per capita during the last twenty-five years. Sugar, a concentrated energy-supplying food, increased in consumption per capita from 14.1 pounds in 1840 to 30.5 pounds in 1860, to 42.9 pounds in 1880, to 52.8 pounds in 1890, to 65.2 pounds in 1900, and to 75.4 pounds in 1908.

The yearly consumption of sugar per family has increased since 1875 by 140 pounds. This has probably not fully displaced a nutritive equivalent in meat, but had it done so the displacement of meat in the annual family dietary would have been equal to 264.4 pounds of sirloin beef, or 349.5 pounds of round beef, or 155.9 pounds of cured ham, or 61.7 pounds of lard.

For every 100 pounds of rolled oats added to the national dietary within less than a generation, if there was an equivalent displacement of meat, for protein there would be required 101.7 pounds of sirloin beef, or 87.7 pounds of round beef, or 183.1 pounds of cured bacon; and for energy the equivalent is 187.8 pounds of sirloin beef, or 248.3 pounds of round beef, or 68.9 pounds of cured bacon.

The needed dietary of a certain number of calories can not be extended considerably and continually with impunity to health; so that if more fruits, vegetables, cereals, and sugar are eaten, some meat must be displaced. Meat, however, still remains the most prominent and costly group of foods.

REDUCTION OF RANGES.

As previously stated, the exports for recent years indicate that something has happened to the production or supply of beef. For 1906 and a few years before, the exports had been much above former figures. That was a period of dumping upon the market great numbers of beef cattle on the breaking up of the big western and northwestern range herds consequent upon enforcement of the "no-fence" law by the National Government.

Half a dozen years of this abnormal movement of beef cattle to the great markets began to tell upon the supply in 1908, when the deliveries fell off in a marked degree and the decrease continued in 1909.

Accompanying this drain upon the beef cattle of the country has been the encroachment of the settler upon the range. Former ranges, broad enough for an empire, have been broken by the farmer's plow. The secret of "dry farming" has been discovered, and one item of its achievements is a large proportion of a durum wheat crop of 50,000,000 bushels.

EXTRA DEMAND FOR CORN FOR FEEDING.

While ranges have been exhausted of their cattle, not all of the animals have gone directly to the slaughterhouses. A great proportion of them have found their way to farms for maturing and finishing, largely upon corn. The extra demand upon the corn crop is recorded in corn prices. From 1895 to 1900 the mean farm price of corn was 28 cents. The price of 60.5 cents in 1901 was due to a two-thirds crop because of drought. The price was quite uniform on a higher level from 1902 to 1906, and the mean was 41.6 cents per bushel. The following year it rose to 51.6 cents; in 1908, to 60.6 cents; and in November, 1909, to 62.2 cents. Higher prices coincide with the breaking up of the range herds.

There is no small difference between the cost of beef made on the free or cheap range and the beef fed on 60-cent corn.

BEEF PRODUCED ON HIGH-PRICED LAND.

There must be taken into the reckoning also the difference between the value of the range acre and the farm acre; also the increased value of the farm acre. Investigations by the Department of Agriculture have established a value per acre, including improvements, for farms of a medium sort in the North Central States in 1905, which was an increase of 35.3 per cent in five years. For the Western division of States the value per acre in 1905 was a gain of 40.2 per cent in five years. These are the groups of States that produce the bulk of the beef supply, and the value of farm land in them has subsequently risen above the figures given for 1905.

The increase in the value per acre of medium farms from 1900 to 1905 was 37.4 per cent in Illinois; 42 per cent in Missouri; 70.6 per cent in North Dakota; 65.2 per cent in South Dakota; 54 per cent in Nebraska; 54.7 per cent in Kansas; 44.5 per cent in Montana; and 81.3 per cent in Wyoming.

More profitable crops have made more valuable land, and cheap beef is not the product of high-priced land.

The settler on the dry farming and irrigated tracts where cattle once grazed is thus far not filling the gap in beef production on the range. The new settler must first give his attention to quick cash crops.

DIMINISHED MARKETINGS OF CATTLE AND HOGS.

The Bureau of Animal Industry gave post-mortem inspections to 7,621,717 cattle in the year ending June 30, 1907; to 7,230,272 cattle in 1908; and to 7,325,337 cattle in 1909, embracing all cattle killed for interstate shipment.

Along with the shrinkage in the supply of beef cattle there has been an increased slaughter of calves, thus augmenting the decrease in cattle supply. The inspections of calves after slaughter numbered 1,763,574 in 1907, 1,995,595 in 1908, and 2,046,713 in 1909.

HOGS AND PORK.

With regard to hogs, high-priced corn must have its effect in high-priced pork. Added to this is the recent great reduction in the marketing of hogs. The inspections of 1907 were 31,815,900, of 1908 were 35,008,027, of 1909 were 35,427,321. These years ended June 30. But for the first nine months of the calendar year the receipts of hogs at the great markets fell from 14,603,700 in 1908 to 12,593,200 in 1909, or 13.8 per cent.

To the industrial disturbance of 1907 is ascribed one cause of the recent diminution in the hog supply. When the bottom fell out of the market late in that year farmers sold brood sows because they were regarded as unprofitable, and the breeding herds thus sacrificed have not been replaced.

Rising prices of beef and pork have strengthened the demand for mutton. The sheep inspected by the Bureau of Animal Industry numbered 9,681,876 in 1907, 9,779,940 in 1908, and 10,802,903 in 1909. Even goats have been affected, since their inspections grew from 46,067 in 1908 to 69,193 in 1909.

In view of the diminished supply of meat animals during the past year, as compared with the population, it is to be expected that stocks of what the commercial papers call "provisions" should be lower than they were a year ago. In 5 chief cities of large storage the stocks of pickled pork decreased from 48,038 barrels October 31, 1908, to 33,991 barrels a year later. Lard decreased from 84,193 to 31,973 tierces during the year and cut meats decreased from 140,853,793 to 89,472,276 pounds.

SUMMARY OF CONCLUSIONS.

The foregoing may now be concisely summarized in a few lines: (1) The production stock of cattle has been diminished by range abandonment; (2) new demands for corn on farms for beef production; (3) high price of corn; (4) high prices of all meat, partly because of high corn prices; (5) the production stock of hogs was reduced in 1907; (6) high farm-land values; (7) both supply and cost of meat production unite to raise meat prices; (8) for seventy years the production of meat has declined relative to population; (9) meat exports increased until 1906, after which they sharply declined; (10) there has been a decreasing meat consumption per capita; (11) increased per capita consumption of cereals, vegetables, fruits, and saccharine foods.

MEAT PRICE MOVEMENTS.

PLAN ADOPTED TO MAKE THEM COMPARABLE.

High meat prices being sensibly felt in the experience of consumers, there is widespread conjecture as to the proportion of the increase received by the various parties from farmer to retail dealer. The foregoing statement concerning factors and conditions of meat production has prepared the way for a critical examination of the price movement of animals and meats. For the purpose of making all things comparable in price movement, a common base is adopted in the manner following.

A period of years is determined upon, beginning with 1896, because that year marks the beginning of the present period of upward movement of average prices of all commodities. The average annual price of the first five years, 1896–1900, is adopted as a base line, or price level, represented by 100, with which the price of each year may be compared upon conversion into a percentage of the price level.

For instance, if the price level or mean annual price of fresh beef of a certain description during 1896–1900 is 7.5 cents and the mean price for 1908 is 9 cents, the price level, 7.5 cents, becomes 100, and the ratio of 9 cents to 7.5 cents is 120, so that the price of 1908 is 20 above the adopted price level.

Whether this computation is made for prices or for other data for the same period of years, all results are comparable one with another, and it is possible to determine, approximately, for illustration, whether the price of steers in Chicago has increased in greater or less degree than the price of fresh beef since 1896.

BEEF PRICES.

Before considering measures of comparative price movements in detail, it may be well to state and remember the measure for all commodities combined. The series of comparative prices index numbers that is adopted for this purpose is one that is everywhere accepted. With the average of the five years 1896–1900 standing for 100, the prices of all commodities reached their highest subsequent point in 1906, when they stood at 126.7; they fell to 116.9 in 1908; and rose to 122.6 in 1909.

NO INCREASE FOR CATTLE.

For cattle other than dairy cows, the annual statistics of the Department of Agriculture show that the latest farm price has fallen below the price level of 1896–1900, that level being placed at 100. The price of cattle for January 1 rose to 110.4 in 1901, descended to 83.9 in 1905, and rose to 93.5 in 1908, and to 96.9 in 1909. Perhaps the price will be shown to have risen to 100 in the investigation of the Bureau of Statistics next January, or to the average with which it began in 1896–1900.

To make certain that the import of the farm price of cattle as above stated is not a mistake for some unperceived reason, the prices of 2-year-old steers have been examined in the unpublished records of the Department of Agriculture. Beginning with a price level of 100 in the first five years of the present period of upward movement of prices, steers of this age reached the price represented by 135.9 in 1900, declined to 85.5 in 1905, and rose to 100.8 in 1909. This is for January 1 and for the United States.

Within the great cattle-feeding State of Iowa, closely related to the ranges, the price of 2-year-old steers reached as high a point as 133.8 in 1900, dropped to 87.2 in 1905, rose to 109.8 in 1907, again fell to 97.6 in 1908, and in the following year touched 103.7.

West Virginia is somewhat of a cattle-feeding State, but, unlike Iowa, depends more on grass than on corn. In this State the price of 2-year-old steers in 1908 is represented by 114.5, and in 1909 by 118.3; and in Tennessee, another grass State, by 105.7 in 1908, and 112.5 in 1909.

The average for the United States as a whole is determined by the corn-feeding States, and for January 1, 1909, as above stated, had barely been able to rise from the trough of 1905 and reach the price level of 1896–1900.

Without further examination it would thus appear that the farmer has not shared in the upward movement of beef prices, and in some degree this is true. The prices of cattle on the farm are ascertained by the Bureau of Statistics from reports from every township for

January 1 of each year, and the averages are regarded as above suspicion. But this marks the beginning of the cattle-feeding period, before corn has been converted into beef. This sort of beef is the product of two raw materials—corn and an animal body in the "raw" state—and such is the animal represented in the farm prices of the Bureau of Statistics, an animal unprepared for Chicago.

SOME RETURN FROM CORN-FED BEEF.

With regard to the prices of beef cattle in the raw state, therefore, the farmer is in about the same position now that he occupied during the first five years of the present price movement. In the matured and finished state, however, his beef cattle have participated to some extent in the advancing prices, as the Chicago prices given below prove. In other words, the farmer has received some share of higher beef prices with respect to corn as a factor of beef making, but has failed to do so with regard to the raw animal. In Chicago, according to a financial authority, the price of the best native steers, expressed comparatively, is 136.4 in 1908 and 139.9 in 1909, the mean for 1896–1900 being represented by 100. Upon the same base line the price of choice to extra steers in the Bureau of Labor's annual reports on wholesale prices is 126.3 for 1908.

Export beef cattle are in a class by themselves to meet international competition. During the fourteen years under review their price was highest in the fiscal year 1897, for which it is represented by 111.4; it declined to 85.6 in 1904; and advanced without interruption to 101 in 1908 and to 104.5 in 1909.

The farm price of corn December 1, 1908, was 212.6, compared with the mean of the five years 1896–1900, and in 1909 the comparative number is 218.6. The matter may now be formally stated as follows:

Item.	Prices index number.	
	1908.	1909.
Two-year-old steers at the farm, not matured or finished, January 1	95.6	100.8
Best native steers, Chicago	136.4	139.9
Choice to extra steers, Chicago	126.3	....
Corn at the farm, December 1	212.6	218.6

It is assumed that the farmer has received his due share of the advance in the Chicago prices of steers; but if so, still he has failed to receive a return corresponding to the increased price of corn in the more recent years, and in these years he has failed to get any increase whatever for his raw animal, except the trace of a gain in 1909.

MARKET RECEIPTS OF CATTLE AND EXPORTS.

The receipts of cattle at Chicago, Kansas City, Omaha, and St. Louis progressed from 5,856,000 in 1896 to 8,170,000 in 1907; then there was a fall to 7,524,000 in 1908, and the number for 1909 will be still lower. The comparative number for the cattle receipts of 1908 is 124.5; for the population of the United States it is 119.3.

The year when the exports of beef were greatest in quantity was 1906, represented by the comparative number 122. Subsequently those exports declined, and the number representing 1909 is 69.7. The great decline in exports and the receipts of cattle at large markets in 1909 would seem to indicate a larger per capita consumption of beef following the industrial depression of 1907–8.

WHOLESALE PRICES OF BEEF.

Pursuing the inquiry another step, wholesale beef prices are to be examined. Their comparison, for 1908, is to be with native steers, represented by 136.4, and with choice to extra steers, 126.3.

One of the large packing-houses has favored the preparation of this matter by contributing the average price of fresh beef sold by it in New York for each of the ten years beginning with 1899. The average prices are between 7 and 8 cents a pound, except 8.52 cents for 1902, 6.97 cents for 1905, and 8.22 cents for 1908. A price level for 1896–1900 being obtained by comparison with prices obtained from other sources, the fresh beef of this packing-house was sold in New York in 1908 at an average price which is represented by 119.8, a lower relative gain than was made by the classes of steers before mentioned.

A trade paper devoted to the provision interests reports mean prices of common to fair native carcasses in New York for 1908, which are related to the price level of the first five years of the period as 129.7 to 100. For native steer carcasses in New York the comparative price for 1908 warranted by the reports of the Bureau of Labor is 120.1. The mean price of beef carcasses in 1908, reported by a commercial authority, is represented by the comparative number 123.7.

While these numbers permit no fine comparisons with the relative price numbers for the classes of steers that are represented by 136.4 and 126.3, respectively, it is apparent that fresh-beef prices have not increased in greater degree than steer prices have at Chicago. The mean export price of fresh beef in 1908 stands relatively at 118.5; in 1909, at 120.9.

The following statement brings together the foregoing comparisons in concise form:

Item.	Prices index number.	
	1908.	1909.
Best native steers, Chicago	136.4	139.9
Choice to extra steers, Chicago	126.3	....
All fresh beef sold in New York by large packing house	119.8	....
Native carcasses, common to fair, New York	129.7	133.6
Native sides, New York (another authority)	120.1	....
Beef carcasses, Chicago	123.7	....
Export price, fresh beef	118.5	120.9

CURED-BEEF PRICES.

There is no obtainable comparative cattle price at Chicago with which the index numbers for cured beef are strictly comparable. The class of cattle for which a comparative number is obtainable nearest to the classes that contribute the cured beef is the class of choice to extra steers already mentioned as being represented by 126.3 for 1908, and these numbers are higher than they would be if they represented the lower classes of cattle from which the cured beef is obtained.

The Bureau of Labor's mean wholesale prices for 1896–1900 being 100, the comparative price of extra mess salt beef for 1908 is 151.9; of western salt hams, 134; of tallow, 139.9. By the same process, with dependence on the reports of a commercial authority, salt family beef is 165 in 1908.

The general conclusion is warranted that cured beef has increased in price in greater degree than fresh beef has and greater than steers have.

The items for cured beef in the following table may be compared with steers and fresh beef in the preceding table:

Item.	Wholesale prices index number.	
	1908.	1909.
Extra mess beef, salt	151.9	....
Western salt hams (beef)	134.0	....
Tallow	139.9	....
Family beef, salt	165.0	154.8
Export price, salted or pickled beef	124.5	141.0
Export price, tallow	137.2	130.9

RETAIL PRICES OF BEEF.

The sole dependence for the series of mean retail prices of beef is the annual reports of the Bureau of Labor on this subject, ending with 1907. For 1908 and 1909 special investigation was made for this report.

Approximately the retail prices of fresh-beef roasts and steaks have increased relatively as the wholesale prices of fresh beef have, with a tendency of steaks to increase more than roasts.

Item.	Retail prices index number.	
	1908.	1909.
Beef, fresh:		
Roasts	122.0	132.2
Steaks	123.3	133.7

SUMMARY OF BEEF PRICES.

The prices of all commodities for 1908 are represented by 116.9 as compared with the price level of 1896–1900; for 1909 by 122.6.

The general conclusion is that the relative increase of the prices of steers at Chicago and of wholesale and of retail fresh beef has been roughly the same, and considerably more than the combined prices of all commodities, while the farmer who has produced or matured beef has participated in the upward beef-price movement only through the corn that he has fed, and then not fully. His cattle, before corn feeding, stand where they did in the price level of 1896–1900, and the best of them for beef purposes have not gained much.

PORK PRICES.

INCREASE FOR HOGS AND CORN.

The situation with regard to hogs is more fair to the farmer than the cattle situation is, but still it is apparent that during the last three years the price of corn has been too high for the price of hogs.

Still continuing to represent the price level of 1896–1900 by 100, the hog may be followed from farm to consumer with regard to relative increase of prices. The reports of the Bureau of Statistics of the Department of Agriculture concerning the farm price of hogs January 1 each year give these animals a standing of 147.3 for 1909, or far below the position of corn in relative price, which was 212.6 for December 1, 1908. Many of these hogs at the time of January 1 are more or less unfinished, and yet exhibit the relative gain in price on the farm that they do when matured with 60-cent corn, as shown below.

SLAUGHTER COST OF HOGS.

The average cost per 100 pounds of all hogs slaughtered at principal markets is indicated by 148.1 in 1908, about the same as the increase in farm price; yet they do not fully return to the farmer the price of the corn fed to them. In Chicago prime hogs are represented by the relative number 160.9 for 1908, according to a commercial authority.

WHOLESALE CARCASS PRICES.

The relative gain of carcasses in price is approximately the same as that of live hogs at the great markets. Compared with the price level of 1896–1900, the price of dressed hogs of 160 pounds in New York in 1908 stands at 145.7, and the carcasses of market pigs at Chicago at 148.4. For 1909 the comparisons stand thus: Hogs on the farm, 147.3; prime hogs at Chicago, 202.3; dressed hogs of 160 pounds in New York, 168.9; carcasses of market pigs at Chicago, 180.5.

When observed in tabular form the foregoing numbers exhibit some rough agreements in the price movements of hogs on the farm, at great slaughtering points, and of carcasses at wholesale. There are differences and irregularities due to differences in the descriptions of the animals.

RETAIL PRICES OF PORK.

The latest year for which the Bureau of Labor's retail index number for fresh pork can be given is 1907 and it is 141.7, or perhaps near enough to the relative wholesale number to indicate approximate agreement in price movement.

Item.	Prices index number.		
	1907.	1908.	1909.
Hogs on the farm, January 1	171.3	136.0	147.3
Cost of all hogs bought at great slaughter points	139.3	148.1	....
Prime hogs, Chicago	139.4	160.9	202.3
Dressed hogs, 160 pounds, New York	158.3	145.7	168.9
Market pigs, carcasses, Chicago	139.1	148.4	180.5
Fresh pork, retail	141.7	....	....

PORK PRODUCTS.

The wholesale prices of most pork products have exceeded the price of hogs, carcasses, and fresh pork, in rate of advance, and all obtainable items with regard to them are assembled in the following table, wherein the facts stated plainly appear:

Item.	Wholesale prices index number.	
	1908.	1909.
Pork:		
Mess	152.7	204.6
New mess (another authority)	179.3	226.3
Salt, mess (another authority)	161.1	....
Bacon, short:		
Ribs, smoked, Chicago	170.5	221.0
Rib sides (another authority)	150.8	....
Do	152.0	200.0
Clear sides	151.9	....
Hams:		
Smoked	113.9	120.7
Smoked (another authority)	122.5	....
Lard:		
Western steam	177.0	223.7
Prime contract	167.7	....
Export prices:		
Bacon	142.9	142.9
Hams	114.6	112.6
Lard	149.2	163.9
Pork (salted or pickled)	149.8	148.1

SUMMARY OF MOVEMENT OF MEAT PRICES.

FARMER'S CATTLE HAVE BARELY ADVANCED.

Starting from the continuous shrinking of the cattle-range area, and more especially the removal of fences a few years ago from the ranges owned by the United States, and from the development of dry farming, which has converted range land into farms in regions of low rainfall, range cattle have been transferred from pasture to feed lot on farms in undue numbers. This increased the demand for corn and helped much to raise its price. The excessive marketing of cattle provided the largest exports of beef and its products in the fiscal year 1906 that this country ever had. The depletion of the stock of breeding animals has gone so far that the people are now facing a much-reduced beef supply.

Coincident with the beef situation came the great fall in the prices of hogs late in 1907, when farmers sold breeding sows so as to diminish a line of unprofitable production. This procedure restricted the pork production with results that are now felt.

In the upward movement of beef prices under the circumstances described, the farmer has not shared equally with packer, wholesaler, and retail dealer. His raw cattle are barely as valuable as they were nine to fourteen years ago, and, had not the price of corn ascended to a high figure, perhaps he would not have shared in the least in higher beef prices. As it is, he is getting a share through feeding corn, but not as much on this account as the price of corn demands.

With regard to hogs the case is different. The farmer has received nearly his fair share of the higher prices of pork in the increased price of his unfed hogs, and he gets some of his due in the corn used for feeding. The price of corn has been too high for the price of pork.

From the moment that the price is paid for the steer or hog in the stock yards to the purchase of the meat and its products by the consumer there are successive additions to price in slaughtering, in wholesaling, and in retailing. The adjustments of these three business functions to one another with regard to their relative share in the final price have remained substantially the same since the period of 1896–1900, which constitutes the base line of this investigation. If the retailer has increased his price of beef and pork, so has the wholesaler and the slaughterer, all with some show of approximation to the same degree as the price of the animal has advanced at the stock yards.

RISING PRICES OF FARM PRODUCTS.

COMPARISON WITH OTHER COMMODITIES.

FARMERS' GAIN IS RELATIVELY GREATER.

The increased cost of living within recent years permits an inquiry as to whether farm products have increased in price in greater degree than other commodities have.

The comparison is preferable for the farm products for which farm prices are known as far back as the beginning of the present movement of advancing prices, which began in 1896. The method will be to take the mean price of 1896–1900 as the base on which the price of each year will be relatively established, this base or mean of the five years mentioned being regarded as 100. Then if the price of a given commodity in a given year is above the mean for the five years its increase will be expressed as above 100, as, for example, by 102; if below, perhaps by 97 or some other number under 100. By this procedure the relative position of the price of wheat on the farm may be directly compared with the prices of other commodities.

In 1909 the relative price of all commodities, according to a commercial authority, is expressed by 122.6, the mean of 1896–1900 being regarded as 100. Only one year, 1906, reached a higher point since 1896, and that was indicated by 126.7.

Among the farm animals, horses exceeded the other kinds in relative increase of farm price, the index number being 264.4; next are mules, with 235.1; swine, with 147.3; and sheep, with 147.1. Cattle are below 122.6, the number for all commodities, milch cows being represented by 120.4 and other cattle by 100.8.

The weighted average for all live stock is 193.1.

All crops for which a farm value per bushel or other unit is known are above the relative increase of price of all commodities. The price of corn per bushel stands at 218.6 in 1909, compared with 100 for the mean of 1896–1900, and no other crop, as far as known, has risen as high, although oats reached 209.6.

Third in order are potatoes, with 192.4; then follow wheat, with 166.2; rye, 162.1; buckwheat, 161.9; tobacco, 161.4; barley, 147.3; cotton, 138.4; hay, 122.9.

All of the foregoing crops may be combined for an average, and this average, which has been weighted, is 180.9. For live stock the average, as previously mentioned, is 193.1. For the crops particularized and live stock combined the representative number is 186.9. This is an average that is weighted according to the values of the various crops and classes of animals. It has not been equaled during the price period under review beginning with 1896. Neither total animals nor total crops have equaled their relative price number for 1909. Animals nearly did so in 1907, for which year their relative number was 191.1, or only a little under the 193.1 of 1909. The average for all crops has at no time been nearer to the 180.9 of 1909 than 172.9 for 1908. In 1907 the relative price number for all crops was 166.7; in 1906 it was 134.6; in 1905 it was 135.6; in 1904 it was 136.9; in 1903 it was 142.2; in 1899 it was 103, and in 1896 it was 90.1, for which year the number representing all commodities was 87.1. Live stock had the representative number of 90.5 for 1896, and crops and live stock combined a weighted average of 90.3.

It is apparent that there has been a tendency of animals and crops of the farm to increase in value per unit at a faster rate than all commodities have increased.

FARM PRODUCTS AND FOODS IN WHOLESALE PRICES.

Some confirmation of this conclusion may be obtained by comparing the farm products with other commodities within the field of wholesale prices, that is, after these products have left the farm and have been more or less manufactured or prepared. The Bureau of Labor's investigations of wholesale prices afford materials, and the prices of 1896–1900 stand for 100; the latest year is 1908.

In that year the average for all commodities had the relative number 126.4, with which may be compared the number 141.9 for farm products, 128.7 for foods after they have left the farm, 121.9 for cloths and clothing, 125.3 for fuel and light, 124.9 for metals and implements, 132.8 for lumber and building materials, 106 for drugs and chemicals, and 119.5 for house-furnishing goods.

In wholesale trade, therefore, farm products exceed all other classes of commodities in relative increase of price since 1896, and food is exceeded only by farm products and by lumber and building materials.

The prices index numbers of a prominent commercial authority afford another opportunity within the field of wholesale prices to compare farm products and foods with other commodities, the latest year being 1909. All commodities have the relative price of 122.6, compared with 100 standing for the mean price of 1896-1900. Wheat, corn, oats, rye, and wheat flour are represented by comparative price numbers that are far above the 122.6 for all commodities, but barley, after being above for the two preceding years, has fallen to 110.2. Beeves stand at 139.9, hogs at 202.3, and horses at 228.8, while sheep are low at 110.7. Beef carcasses are at 122.6, or the average for all commodities, while pork and mutton carcasses and all meat products are far above.

Milk at New York is represented by 129.8, eggs by 205.1, creamery butter by 151.7, factory cheese by 145.3, salt mackerel by 108.2, and codfish by 153.1. Below the average are found coffee at 110.1, granulated sugar at 87.2, tea at 74.7, New Orleans molasses at 81.6, fine salt at 100.9, and rice at 100.6; but beans are represented at 163.4, peas by 146.8, potatoes by 152.2, and apples by 190.8. Ohio and Pennsylvania wool is placed at 137.3 in the scale of relative prices, or considerably above the general average of 122.6; native steer hides are at 167.9, and Burley tobacco at 177.5.

In the prices index numbers now under consideration the grouping of somewhat similar commodities into classes was not done before 1898, so that for the purpose that follows the mean of 1898–1900 is adopted as the base price level represented by 100. The number for all commodities then becomes 115.2. For the class of breadstuffs the representative number is 155.8; live stock, 165; provisions, 127.1; fruits, 90.1; hides and leather, 126.1; textiles and metals, each 107.7; coal and coke, 107; oils, 122.5; naval stores, 104; building materials, 87.6; chemicals and drugs, 84.

The general fact is that in the upward movement of prices since 1896 the products of the farm have fared better than any other class of commodities, the only large item that is an exception being unfed beef cattle, the farm price of which has now barely begun to rise above the price level of 1896–1900 for beef cattle.

WORK OF THE DEPARTMENT IN 1909.

ENFORCEMENT OF THE FOOD AND DRUGS ACT.

The Food and Drugs Act locates in the Bureau of Chemistry the examination of specimens of foods and drugs for the purpose of determining whether such articles are misbranded or adulterated. In all other respects the law speaks to the Secretary of Agriculture, who under the act is charged with its enforcement. The advisory work is intrusted by the Secretary to the Board of Food and Drug Inspection and the Referee Board of Consulting Scientific Experts. The legal work is in the hands of the Solicitor of the Department of Agriculture.

CHEMICAL WORK.

Samples of suspected foods and drugs are collected in the course of interstate commerce by a force of inspectors connected with the Bureau of Chemistry, who also make sanitary inspections of factories. Samples of imported products are obtained through the agents of the Treasury Department.

The samples collected are first examined in the branch chemical laboratories, of which there are 21, situated at important ports of entry and commercial centers throughout the country, as follows: Boston, Buffalo, Chicago, Cincinnati, Denver, Detroit, Galveston, Honolulu, Kansas City, Nashville, New Orleans, New York, Omaha, Philadelphia, Pittsburg, Portland, Oreg., St. Louis, St. Paul, San Francisco, Savannah, and Seattle. At these laboratories, also, preliminary hearings are accorded the manufacturers and dealers concerned. When these examinations indicate that the product in question fails to comply with the law, the samples are forwarded to Washington, where another analysis is made in the Bureau of Chemistry, and opportunity for a full hearing before the Board of Food and Drug Inspection is accorded. When in any case the Board is satisfied that the law has been violated, the facts are reported to the Solicitor, who prepares the papers in the case for transmission to the Department of Justice, by whose officers the prosecution is conducted before the proper United States court.

Following this procedure about 1,300 factories were inspected during the year. About 15,000 samples of foods and drugs passing in interstate traffic were taken, of which 9,631 were submitted to examination in the branch laboratories, with the result that more than 2,000 were forwarded to Washington and reexamined in the Bureau of Chemistry. Of imported products the branch laboratories examined 8,476 samples, about 2,500 of which were sent to Washington for reexamination. In addition, more than 79,000 samples of imported goods were submitted to floor inspection at ports of entry, without examination in the laboratory. Preliminary hearings to the number of 6,901 were conducted at the branch laboratories.

ADVISORY WORK.

In the enforcement of the Food and Drugs Act this Department has to do with two classes of foods and drugs; first, those which enter interstate commerce or are sold or manufactured within the District of Columbia or the Territories, and, second, those offered for import into the United States at the various ports of entry.

After an examination of samples of suspected foods and drugs has been made by the Bureau of Chemistry the report of that Bureau is given to the Board of Food and Drug Inspection. If it appears to the Board that there has been a violation of the provisions of the food law, citations are issued to the person from whom the samples were purchased in order that he may appear and give evidence as to the facts in the case. As a matter of courtesy hearings are always granted every person who may have an interest in the case. Such hearings are always private.

The Board can not personally attend every hearing, except such as are held in the city of Washington. Hearings are granted at points where the branch laboratories of the Bureau of Chemistry are situated and are always held at such laboratories nearest and most convenient to the person cited. After the evidence has all been collected the cases are again considered by the Board, with the result that they are either dismissed, placed in permanent abeyance, or submitted to the Solicitor of the Department for the preparation of the cases in legal form. These cases then come to me for my final consideration as to whether or not they should be referred to the Department of Justice for prosecution.

Many of the questions which have come before the Board for consideration are exceedingly perplexing, and it has often been necessary to hold public hearings, at which anyone interested in the subject under discussion has an opportunity to appear and present such evidence as is deemed pertinent to the question. This plan has always been pursued by the Board in the consideration of large questions, and in nearly every case, as the result of the hearings, formal decisions have been issued. Since the law was passed more than seventy food-inspection decisions have been issued for the guidance of those interested in the food law and the rulings under it. These decisions have no judicial force; they are merely statements of the Department's views and policy, and after their issuance it is customary to allow sufficient time to elapse before they are put into effect.

Under section 3 of the law the Secretary of the Treasury, the Secretary of Agriculture, and the Secretary of Commerce and Labor are empowered to make uniform rules and regulations for its enforcement. On October 16, 1906, what is known as Circular 21 of the Office of the Secretary was published. This contains the "rules and regulations" for the enforcement of the Food and Drugs Act. As experience has been gained in the enforcement of this law, necessity has arisen for adding to and amending the rules and regulations, and since the issuance of the first edition of Circular 21 ten rules and regulations have been promulgated by the three secretaries above mentioned. Some of these regulations are modifications of those already existing, while others deal with new subject-matter.

Attention might be called here to the public hearings which have been held, because they are important as showing the method of getting in touch with the manufacturers so as to have full information prior to the rendering of decisions. For example, the bleached flour hearing took five days for its completion, and the evidence given was very full. As a result of this hearing a decision on the subject was rendered by the Department. At the present time the matter is in the courts because of manufacturers who have not been willing to accept the views of the Department. It is expected that before long the question will be settled by the courts. Attention should be drawn also to the public hearing which was given on the labeling of mineral waters. This was very largely attended, and after mature consideration of the evidence submitted a decision was given expressing the opinion of the Department as to the proper labeling to be placed on beverages of this type. General hearings were given also on the subjects of the labeling of yeast, weights and measures, labeling of chocolate and cocoa, oysters, New Orleans molasses, alum, etc.

It has been my observation that the manufacturers and jobbers have appreciated the efforts of the Department to obtain full information before the issuance of decisions, and in general it may be said that practically no complaint has been received after the decisions have been issued, and they have been quite generally complied with. In this way the law has been administered without undue harshness, and yet the results which it is the object of the law to attain have been and are being obtained. It is not the desire of the Department to make this law an instrument of oppression, but rather to get good results by the means indicated. In no case, so far as known, has the Department reported for prosecution cases against others than the persons who were originally responsible for the adulteration or misbranding; that is, it has been my desire to put the responsibility nowhere else. It is only by going to the fountain-head that the results can be obtained. No good can be obtained by prosecuting the middleman.

"Adulteration" is an ugly word in the popular mind. It carries with it the idea that there is grave danger to the public health when adulterated foods are consumed. This may or may not be true. Under section 7 of the Food and Drugs Act, adulterants are of two kinds, namely, (1) those which may be injurious to health, and (2) those which are not unwholesome but which debase the character or value of the food. Adulteration of the latter type wholly disappears when the foods are properly branded so that the consumer knows exactly what is being purchased. The question of the effect on health of "preservatives" in foods is in many instances very delicate. There is apparently but one way in which questions of this kind can be properly decided, and that is by means of experimental work. In some cases there appears to be a very marked difference of opinion among men who might be presumed to have the right to speak with authority on questions of this kind. The Department has therefore pursued the policy of submitting these large matters to what is called the "Referee Board of Consulting Scientific Experts," the personnel of which is such that the results obtained by them must of necessity carry conviction. This Board was first organized shortly after the pure-food law went into effect, and the members were chosen by ex-President Roosevelt after correspondence with the heads of a large number of the most prominent universities of the United States, and on his suggestion the men were appointed by me. The board at present consists of the following members: Ira Remsen, president of Johns Hopkins University; Russell H. Chittenden, director of the Sheffield Scientific School, Yale University; Alonzo E. Taylor, University of California; C. A. Herter, College of Physicians and Surgeons, New York; and John H. Long, Northwestern University, Chicago. Several of the larger questions have been referred to this Board, but as yet only one has been reported upon, namely, the effect upon health of sodium benzoate. This report is published by the Department as Report 88 and comprises 784 pages, in which all the details of three separate sets of feeding experiments are given. Clinical details are given and in fact all such data as were used in reaching the conclusions. This report describes probably the most extended experiment of its kind ever undertaken in any country. Based upon this report, the Secretary of the Treasury, the Secretary of Commerce and Labor, and myself, who are empowered by the act to make rules and regulations for its enforcement, promulgated Food Inspection Decision 104, which states that benzoate of soda may be used in foods, provided the amount used is clearly stated upon the container or package of food containing this substance. To the Referee Board there has also been referred the effect of sulphur dioxid, of saccharin, and of sulphate of copper on health, the latter being the substance ordinarily used in the greening of vegetables, many of which are being offered for entry into the United States. This Board is now engaged in the work submitted to it, and it is expected that reports will be received shortly on some of the questions which are now in its hands for experimentation and investigation.

The Department has carefully scrutinized the foods and drugs offered for entry at the various ports of the United States, with marked results. New York is the port at which perhaps 75 per cent of the foods and drugs are entered, and next in line comes Boston. There has been little difficulty in the enforcement of the law at the various ports on the whole. It may be said, however, that in some lines the entire character of products offered for entry has been changed, and products of a much higher grade are now imported. For example, it has been customary in the past for all case goods of edible oils, wines, liqueurs, distilled spirits, etc., to have marked on the outside not only the number of bottles or cans contained in the case, but also their contents. Examination has shown that such marking of contents has been very largely incorrect, but at the present time, through the work of the Department, very few, if any, fraudulent and misbranded cases are offered for entry. Olive oils are now offered at the ports of such a character that it is rare that one containing other oil is found.

Recently, importations of figs have been investigated. Information secured by the Department indicates that many of the packing houses in which figs have been packed in foreign countries are very insanitary and unhygienic, and that the products of these establishments constitute a distinct menace to the public health. In order to rectify these conditions no figs are now allowed entry into the United States unless accompanied by a certificate properly viséed by one of our American consuls, indicating the character of the conditions under which the packing has taken place. This does not of itself, however, secure immunity against inspection; on the contrary, figs which had been packed under sanitary conditions have been refused entry by the Secretary of the Treasury because of their wormy and moldy condition. As a result, the people of the United States are now receiving a clean and wholesome product, packed under proper conditions.

One of the most flagrant violations of the Food and Drugs Act was the shipment of coffee coated with a mineral poison—lead chromate. Eighty-four sacks of this coffee were seized and destroyed by order of the court. Criminal proceedings were brought against the shipper of this poisonous coffee and a fine was imposed.

Very few cases of the use of questionable preservatives are now encountered at the ports. Salicylic acid, boric acid, fluorides, and similar substances have practically disappeared from foodstuffs offered for entry, as well as foodstuffs manufactured within our borders and offered for interstate commerce. This result is especially gratifying because accomplished without recourse to the courts. It is true, however, that with respect to boric acid there are a few firms who have held out against the decision of the Department, but cases affecting them are now pending in the courts and it is expected that a judicial decision for our guidance will soon be given.

Too great importance can not be attached to the character of the work done at the ports in controlling the drugs coming to this country. Very often the drugs are such that the Secretary of the Treasury, with whom I cooperate in the Board work for detentions, orders reexportation, as he has authority to do under section 11 of the Food and Drugs Act, where the products detained may be of such character as to prove dangerous to the health of the people of the United States. To illustrate: Certain Chinese pills are offered for entry as being remedial in cases of persons afflicted with the opium habit. Examination of these pills has shown that they contain material quantities of opium or morphine, and without doubt such products are of a fraudulent character and as remedial agents for the opium habit are absolutely dangerous. Crude drugs from which remedial agents are to be prepared have been rejected where the remedial agent prepared therefrom was not of a character capable of being standardized, and when the crude drugs are weaker than prescribed by the United States Pharmacopœia. As a result of this drastic but absolutely necessary action the character of the crude drugs offered for importation has been very materially improved, and exportation is not resorted to as frequently as formerly.

LEGAL WORK.

There were reported through the Solicitor to the Attorney-General and United States attorneys 494 cases of violations of the Food and Drugs Act, 359 more than were so reported during the previous year. Eighty-five cases resulted in conviction and fines of $2,002, with costs of about equal amount; 98 cases resulted in decrees of condemnation and forfeiture of many tons of goods, both foods and drugs; only 2 cases were lost by the Government; 2 seizure cases are pending on appeal to the circuit court of appeals; 135 cases were dismissed; 53 civil, 74 criminal, and 42 seizure cases were pending in the courts at the close of the year. Many of the 135 cases dismissed were accompanied by mitigating or palliating circumstances which caused the Department to recommend their discontinuance.

Among the cases reported and successfully prosecuted during the year were upward of 75 cases involving the adulteration of milk and cream, shipped from outlying districts to St. Louis, Kansas City, Cincinnati, and Chicago. This crusade has resulted in the material purification of the milk supply of these cities. A number of the more pernicious nostrums, extensively advertised and sold as cures for cancer, diphtheria, skin diseases, headaches, etc., have been excluded by successful prosecutions from interstate commerce, and substantial progress has been made in the improvement of the quality of flavoring extracts.

The question of the constitutionality of the act was decided in the western district of Missouri, the court sustaining the validity of the act.

A writ of mandamus to compel the Secretary of Agriculture to withhold the recommendation of prosecutions against manufacturers and shippers of flour bleached by a certain process using nitrogen peroxid was denied by the court, and the decision was approved by the court of appeals of the District of Columbia.

There were published during the year 66 notices of judgment, provided for by section 4 of the Food and Drugs Act. The demand for these notices is great, and it is apparent that manufacturers and dealers are closely watching the operation of the law.

OTHER LEGAL OPERATIONS OF THE DEPARTMENT.

The Department has continued, through the Office of the Solicitor, the enforcement of the Food and Drugs Act, the Meat-Inspection Law, the Twenty-eight-Hour Law, and such other laws and regulations as come properly under the jurisdiction of this Department. Prosecutions for violations are being vigorously carried out through the United States attorneys. This work has steadily increased, and the year ending June 30 last showed an increase over any previous year. The preliminary investigation and gathering of data necessary to perfect these cases for action in the courts have been carried on in the Office of the Solicitor, as well as the large volume of correspondence with United States attorneys relative to the maintenance of the cases in the courts. Briefs covering constitutionality, construction, and interpretation of the several laws committed to the Department for administration and enforcement have been written by the Solicitor at the request of the United States attorneys for use in contested cases, and almost daily advice and suggestions have been given United States attorneys in response to their requests for such assistance.

FOOD AND DRUGS ACT.

The legal work under this statute has already been discussed in connection with the chemical and advisory work necessary to its enforcement.

THE TWENTY-EIGHT-HOUR LAW.

In addition to 828 cases pending at the beginning of the year, there were 208 cases of violation of the Twenty-eight-Hour Law reported during the year, a decrease from the previous year of 477 cases, or 70 per cent. Penalties were collected amounting to $73,490 and costs $11,539.85, an increase over the previous year of $11,960 and $4,338.14, respectively. Of cases decided, only 33, or about 5 per cent, resulted adversely to the Government. The law has been vigorously enforced, and the decrease in the number of cases reported is gratifying evidence that the railroads are now complying in an appreciable measure with the requirements of the act.

The much-discussed question of what constitutes the unit of violation may be considered as finally settled, the decisions of several Circuit Courts of Appeals affirming the contention of the Department that each separate shipment constitutes an offense.

In practically all cases in which an interpretation of the meaning of the act was submitted to the courts the decisions have favored the contentions of the Government.

Bills have been introduced in two Congresses requiring the railroads to maintain a 16-mile rate on stock trains, but they have thus far failed of passage. It is believed that such a law would greatly facilitate the safe and humane transportation of animals in interstate commerce.

SUPPRESSION OF CONTAGIOUS DISEASES.

Nine cases of violations of the act for the suppression of contagious diseases among domestic animals were reported to the Attorney-General, and four remained unsettled at the end of the preceding year. One resulted in a fine of $100; eight were pending at the close of the year; two were dismissed; in one the grand jury failed to indict; and in one the defendant was discharged on preliminary hearing.

OFFENSES AGAINST THE QUARANTINE LAW.

Thirty-three cases of violations of the quarantine law were reported to the Attorney-General and five remained unsettled at the close of the previous year. Four cases resulted in fines of $300 in one, $100 in two, and in one $100 with a commitment to jail for thirty days; one resulted in acquittal; the grand jury failed to indict in three; one was withdrawn; and twenty-nine were pending at the close of the year.

The law is working admirably and has already accomplished beneficial results far in excess of the most sanguine expectations.

MEAT INSPECTION.

Only 44 cases of violations of the Meat Inspection Law were reported. These offenses are almost invariably committed by individuals and rarely by large establishments. There were fifteen convictions, seven dismissals for lack of evidence, and the rest were still pending at the close of the year.

NEED FOR FEDERAL INSPECTION OF INSECTS AND NURSERY STOCK.

In January, 1909, the authorities of the State of New York informed the Department that the brown-tail moth had been found in that State in shipments of seedlings received from Angers, France. Later it was learned also that the winter nests of this pernicious moth had been found in Ohio, on seedlings imported from the same French locality. By arrangement with the Treasury Department and the principal railroads, the Department was then promptly notified of the final destination of all cases of plants received, and was thus enabled to notify state inspectors or other competent persons near the destinations. Notices of nearly 800 shipments, divided among 35 States, were thus sent out. In 15 of these States nests of the brown-tail moth were found. Proper inspection was probably had in all cases, and it is likely that this concerted effort to prevent a new introduction of the brown-tail moth was for the time successful.

What we need is a federal statute which shall not only forbid the importation or interstate transportation of injurious insects in all stages, with adequate penalties for its violation, but also provide for a thorough system of inspection and quarantine, at ports of entry, for nursery stock and other materials on which such insects may be imported, as well as a sufficient means of control of interstate transportation of such materials. Such an inspection, in conjunction with the admirable systems now in existence in the States, would provide the country with a reasonable degree of protection against additional introductions of insect pests.

CHANGES IN THE PERSONNEL.

The total force of officers and employees on the rolls of the Department July 1, 1909, as shown by the report of the appointment clerk, numbered 11,140, a net increase of 720 during the fiscal year. The force employed in Washington numbered 2,317, and 8,823 were employed outside of Washington. During the year 24,494 appointments of every description were made. Of these, 16,938 were in the manual-labor grade, for temporary employment in the fields and forests and at stations outside of Washington, the appointments being for short periods, usually averaging three months. The number of persons receiving probationary appointments, equivalent to absolute appointment if retained in the service after the probationary period, was 1,492. There were reinstated 52, and transferred from other departments 61. During the year there were 511 resignations and 38 deaths, while 53 were separated from the service for misconduct. On July 1, 1909, there were 1,237 employees on the statutory roll (positions specifically provided for by the act of Congress making appropriations for the Department), and 9,903 were paid from lump-sum appropriations. The large number of emergency appointments is made necessary by the varied experiments, demonstrations, meat and food inspection, work on the National Forests, extinction of injurious insects, etc., where temporary help is required.

WEATHER BUREAU.

FORECASTS AND WARNINGS.

The scientific investigations of the Weather Bureau have been carried on successfully at the Mount Weather Research Observatory during the year. Additional knowledge of conditions in the upper atmosphere has been gained by means of kites and captive balloons, which have been sent into the upper air with instruments for recording the conditions of temperature, moisture, and winds at varying altitudes. The heights attained in these flights were greater than in the preceding year, but still greater altitudes are desirable in order to complete the needed series of observations.

These upper-air observations have been used with benefit in weather forecasting for the Atlantic Coast States, the atmospheric conditions at elevations of 8,000 to 10,000 feet having been found to bear definite relations to weather changes that subsequently occur at the surface of the earth in this region. For instance, it has been found that the average wind direction at Mount Weather at about 10,000 feet above sea level is northwest, and that shifts of wind to west and southwest usually forerun by about two days the beginning of rain on the middle Atlantic seaboard. Continued observations will doubtless reveal other conditions a knowledge of which may prove of positive value in practical weather forecasting.

It is proposed to supplement the Mount Weather flights with others obtained through the liberation of free balloons during the coming year. On account of its proximity to the ocean, the research station will not be the scene of these flights; they will be made in the interior portion of the country, some of the balloons being liberated near a storm center and others sent up simultaneously some hundreds of miles to the eastward. Another line of experiments will be conducted at high stations in Nevada or Colorado, for the purpose of determining the changes in the atmosphere in a vertical direction.

Eight ascensions have so far been made, in each of which the altitude attained by the free balloon equaled or exceeded 10 miles. On October 12, at Omaha, Nebr., a height of 15 miles, hitherto unprecedented for this country, was attained, and on October 6, at Indianapolis, Ind., a height of nearly 14 miles was reached. The last-named ascension was made in almost the center of a great area of high pressure. The balloon was observed to move in a southwesterly direction at all altitudes, and was later found in that direction about 30 miles from the city. A similar movement—that is, a drift of the air at high altitudes toward the southwest—was observed at Omaha, Nebr. This would seem to indicate that the control of the general atmospheric movements exerted by areas of high pressure extends upward to greater altitudes than has hitherto been suspected.

In general, the results of the ascensions so far as available are in close accord with European observations. The great isothermal layer was reached on eight occasions; its lower limit varied greatly in altitude from day to day and for different surface weather conditions.

In addition to its daily forecasts, the Weather Bureau has issued forecasts for about a week in advance, as conditions warranted, from time to time. In practically every case these long-range predictions have met with a high degree of verification. On July 9, 1908, a forecast of a warm wave was issued some days in advance of its expected occurrence, and it was announced at the same time that it would be succeeded by much-needed rains in the Ohio Valley and Middle Atlantic States. The warm wave that followed was the most intense of the summer of 1908, and the rains came after as predicted. Similar forecasts of drought-relieving rains, tropical storms, frosts, and cold waves were followed by the conditions expected. These forecasts have been made possible through the additional information obtained from upper-air observations and by means of a system of observations covering the entire northern hemisphere.

KEY WEST HURRICANE.

In looking for single instances of important service rendered by the Weather Bureau the best illustrations will perhaps be found in its advance warnings of the destructive storms that from time to time visit the Atlantic and Gulf coasts. This generally accepted truth has received fresh confirmation in the history of the Key West hurricane of October 11, 1909. From the time this storm was first definitely located over the south-central Caribbean Sea, on the 6th, until it crossed the southern extremity of Florida and passed into the ocean, on the 11th and 12th, the Weather Bureau gave out daily advices regarding its intensity and the direction of its movement at every stage of its progress. The Bureau ordered storm warnings at the southern Florida coast stations on the 10th; at 6 a. m. of the 11th these were changed to hurricane warnings at Key West and Sand Key, and a special bulletin followed, giving a full account of the dangerous conditions then existing and describing the probable future course of the storm. Shipping in the affected area had already been warned to seek refuge.

Under orders from the Key West official the Weather Bureau men at Sand Key left their station for the light-house near by, where they continued observations during the storm. At the time the station was abandoned the wind was blowing at a rate of 75 miles an hour. An estimated velocity of 100 miles an hour was reached later, and at the height of the storm the island was covered with water. At 10.30 a. m. the Weather Bureau building was swept into the sea.

At Key West the barometer fell to 28.50 inches at 11.45 a. m., the lowest reading ever recorded at the station. Between 11 a. m. and 4 p. m. the wind velocity ranged from 68 to 76 miles an hour. During this time hundreds of buildings were blown down, many vessels were swept from their moorings, and some were wrecked, and at least six lives were lost. The total financial loss at Key West is estimated at $2,000,000 to $3,000,000.

After passing Key West the hurricane swept the Florida peninsula south of Miami. The damage between the two points is said to have aggregated millions of dollars, and 11 deaths are reported. Additional loss of life undoubtedly occurred among the fishermen and spongers and those dwelling on the low-lying islands or keys that fringe the coast of the southern Florida peninsula, since they were outside the zone of communication. Protective measures following the receipt of warnings reduced losses both of life and of property to a minimum, however, wherever the information could be given. The preparations made by the East Coast Railroad officials unquestionably saved hundreds of their employees from death. About 3,000 men were engaged on their construction works, but were withdrawn from their exposed position to places of safety upon receipt of the warnings. The vice-president of the line says:

> Positively not a life was lost in the storm. Very little damage was done to the right of way or to work on the extension. The road will be open to traffic within a few days to Knights Key. Warning by the Weather Bureau enabled us to fully protect all employees and equipment.

Three years before these same extension works were visited by a storm of less intensity than the one just experienced. Although warnings of its coming had been given, its arrival found the men unprepared; the high winds blew the boats in which they were quartered out to sea, and more than a hundred were drowned. As the recent storm was more severe than its predecessor, it is evident that the loss of life in this particular case would have been greater than it was three years ago had it not been for the protective measures that were taken as a result of the Bureau's warnings.

RIVER AND FLOOD SERVICE.

Great damage was done along the interior streams of central Kentucky in March, but with this exception there were no floods in the great rivers of the eastern and east-central portions of the country. At various times, however, floods occurred in the rivers of the Carolinas, Georgia, Alabama, Arkansas, Oklahoma, Kansas, Colorado, and California, the combined damage amounting to between $16,000,000 and $17,000,000. All of the flood stages were accurately forecast by the Weather Bureau. The losses reported were of an unavoidable character, while the value of the property saved as a result of advance warnings probably equaled the total amount of loss.

Two new river districts were established during the year, as follows:

1. Bismarck, N. Dak., with territory comprising that portion of the watershed of the Missouri River from Bismarck westward. This territory was formerly a part of the Sioux City, Iowa, district.
2. Wichita, Kans., with territory comprising that portion of the watershed of the Arkansas River from Wichita to the Kansas-Colorado line. This territory was formerly a part of the Fort Smith, Ark., district.

WATER RESOURCES.

The study of snowfall conditions in the mountain regions has been furthered by the establishment of a large number of observing stations in the more inaccessible sections of the country. The Weather Bureau has cooperated in this work with other government bureaus engaged in irrigation and reclamation projects. As the plans progress it is expected to complete a set of observations that will greatly increase the knowledge of the annual snowfall in those remote districts from which the western streams receive their water supply.

EVAPORATION STUDIES.

This work has continued at the evaporation stations on the Salton Sea and has been taken up at several of the western Reclamation Service projects and at stations of the water resources branch of the Geological Survey in the territory east of the Mississippi. Information regarding evaporation is needed in connection with the engineering and reclamation work now being carried on in the arid districts of the West, and present arrangements provide for simultaneous measurements of evaporation in every type of climate.

BUREAU OF ANIMAL INDUSTRY.

The work of the Bureau of Animal Industry not only deals with the live-stock industry, but has an important bearing on the public health through the meat inspection, through efforts for the improvement of the milk supply, and through the investigation, prevention, and eradication of diseases which affect man as well as the lower animals. Indeed, the animal and the human phases of the Bureau's work are so closely related and interwoven that they could not be separated without detriment to the efficiency of the service and without causing considerable duplication of work and expenditure.

In studying and eradicating animal diseases the work is often of indirect benefit to human health. In the meat inspection the knowledge required is primarily that of animal diseases and comparative pathology rather than of human medicine. While the wholesomeness of dairy products is of great importance to human health, the methods by which wholesome and sanitary dairy products are to be obtained are mainly questions for the veterinarian, the dairy bacteriologist, and the scientific dairyman.

Erroneous and misleading statements have been published to the effect that large sums are spent by the Department of Agriculture for the health of animals while practically nothing is spent for the protection of human health. It should be remembered that the Department's work through the Bureau of Animal Industry, besides including the study, prevention, and stamping out of animal diseases, accomplishes much for the health of the people, especially through the meat inspection and the work for purer milk.

MEAT INSPECTION.

The meat inspection has continued to grow in magnitude until it has almost reached the maximum that can be carried on under the standing appropriation of $3,000,000 made by Congress, the expenditure for this work during the fiscal year having amounted to $2,884,000, an increase of about $165,000 over the previous year. The inspection was conducted during the past fiscal year at 876 establishments located in 240 cities and towns, an increase of 89 establishments and 29 cities and towns.

There were inspected before slaughter 56,545,737 animals, consisting of 7,588,144 cattle, 2,063,579 calves, 35,831,552 hogs, 10,992,579 sheep, and 69,883 goats. The animals inspected at and after slaughter numbered 55,672,075, of which 7,325,337 were cattle, 2,046,711 calves, 35,427,931 hogs, 10,802,903 sheep, and 69,193 goats. Of these, 141,085 carcasses and 899,628 parts of carcasses were condemned. Tuberculosis continues to be the cause of condemnation of the greater portion of the condemned cattle and hog carcasses, and over 99 per cent of the condemnations of parts of hog carcasses were due to this disease.

Nearly 7,000,000,000 pounds of meat food products were prepared and processed under the supervision of the government inspectors, and there were condemned on reinspection 24,679,754 pounds of meat products which had become sour, tainted, putrid, unclean, or, in the case of fats, rancid since inspection at slaughter. These latter condemnations show a decrease of 43 per cent from those of the previous year, indicating that the close supervision and strict sanitary requirements of the Department under the authority given by the new meat-inspection law have brought about great improvement in sanitary conditions and in the methods of handling meat products.

The Department maintains a constant and close surveillance over all its work of meat inspection. No less than seven traveling inspectors go about among the various stations, the times of their visits being unknown beforehand to the local employees. It would be exceedingly difficult for corruption or inefficiency to reach serious proportions or to exist very long without detection.

INSPECTION OF EXPORT ANIMALS.

The outbreak of foot-and-mouth disease caused a considerable reduction in exports of cattle and sheep. The Bureau of Animal Industry made during the fiscal year 397,925 inspections, including reinspections of 227,255 animals for export from the United States, besides inspecting 50,943 Canadian animals in transit through the United States for export. There were inspected on arrival at British ports, by Bureau inspectors stationed there, 259,297 animals from the United States and Canada. During the year 473 inspections of vessels carrying live stock were made in order to see that the fittings, equipment, ventilation, feed, water, attendants, etc., conformed to the regulations.

INSPECTION AND QUARANTINE OF IMPORTED ANIMALS.

In order to prevent the introduction of contagious diseases of live stock the Bureau makes a rigid inspection of all imported animals at ports of entry, and a quarantine is imposed upon animals from all parts of the world except North America. During the fiscal year 237,804 imported animals were inspected, 4,760 of which were also quarantined.

CONTROL AND ERADICATION OF CONTAGIOUS DISEASES OF LIVE STOCK.

FOOT-AND-MOUTH DISEASE.

The outbreak of contagious foot-and-mouth disease, referred to in my previous report, was stamped out after a vigorous campaign by this Department in cooperation with the authorities of the affected States. The disease was discovered in Pennsylvania early in November, 1908, and the territory affected comprised fifteen counties in Pennsylvania, five counties in New York, two counties in Michigan, and one county in Maryland. The plan of eradication followed was similar to that successfully employed six years previously in the New England outbreak, namely, to enforce a strict quarantine, to discover all infected animals and localities, and to slaughter and bury all diseased and exposed animals and disinfect the premises occupied by them. The condemned animals were appraised and the owners were paid the full appraised value, two-thirds by the Department and one-third by the State. The expenses of burial, disinfection, etc., were shared in the same way.

The total number of animals slaughtered was 3,636, and their total appraised value was $90,033.18. The figures by States are as follows: In Pennsylvania, 1,232 cattle, 1,000 hogs, 52 sheep, 4 goats; a total of 2,288 animals, valued at $58,667.22, on 101 premises. In New York, 520 cattle, 246 hogs, 214 sheep; a total of 980 animals, valued at $24,378.13, on 45 premises. In Michigan, 242 cattle, 23 hogs, 9 sheep, 3 goats; a total of 277 animals, valued at $5,359, on 9 premises. In Maryland, 31 cattle, 60 hogs; a total of 91 animals, valued at $1,628.83, on 2 premises.

The Bureau of Animal Industry had a force of 572 men, including 159 veterinarians, engaged in the work of inspection and eradication. In addition to the work of slaughter, burial, and disinfection, a vast amount of work was done in thoroughly canvassing the infected regions, going from farm to farm and inspecting all animals, and in investigating rumors of disease so as to detect all cases. The number of visits made by the Bureau's inspectors was 108,683, and the total number of animals inspected, including reinspections, was more than a million and a half. Besides the infected States the inspectors visited points in Ohio, Indiana, Kentucky, West Virginia, Virginia, New Jersey, Delaware, and Connecticut in tracing rumors.

The federal quarantine, which was first placed upon four counties in Pennsylvania, effective November 13, 1908, was extended from time to time as additional territory was found to be infected. With the progress of eradication the quarantine was modified and partly released from time to time, as conditions warranted, and was entirely removed April 24, 1909.

The amount expended by the Department of Agriculture in eradicating the disease was barely kept within the special appropriations, aggregating $300,000, made by Congress for that purpose. Fortunately the disease was confined to practically the territory infected at the time of its discovery and was prevented from spreading to other sections. If it had persisted longer or spread farther, it would have been necessary to call upon Congress for additional funds.

On tracing the origin of the disease, which was at first a matter of mystery, it was soon found that the cattle which carried it into Pennsylvania came through the Buffalo stock yards, and from Buffalo suspicion pointed to Michigan. I visited Buffalo and Detroit, in company with the Chief of the Bureau of Animal Industry, in order to give personal attention to the situation. It was believed from the first that the contagion must have come from abroad, yet in view of the Department's strict quarantine on imported live stock it was considered improbable that it could have been brought in with animals, and other means of entrance were looked for. When inspectors of the Bureau of Animal Industry traced the disease to certain calves that had been used by a Detroit firm for the propagation of smallpox vaccine it was regarded as very probable that the vaccine was contaminated with the virus of foot-and-mouth disease and that the outbreak was due to this cause. I therefore directed that a careful scientific investigation be made to determine this point, and the work was intrusted to Dr. John R. Mohler, of the Bureau of Animal Industry, and Dr. Milton J. Rosenau, of the Public Health and Marine-Hospital Service, that Service having been invited to join in the investigation because it was charged by law with the supervision of biological products used in human medicine.

These investigators by a noteworthy piece of scientific work demonstrated that the smallpox vaccine virus of the Detroit firm was in fact contaminated with foot-and-mouth disease, and, further, that the vaccine of a Pennsylvania firm, from which the particular strain of vaccine in question was obtained by the Detroit firm, was likewise contaminated. While it is not positively known just how long the contamination had existed at the Pennsylvania establishment, it seems probable that it was introduced with vaccine virus imported from Japan in 1902, and that it was the cause of the New England outbreak of that year.

The introduction of the contagion through contaminated vaccine shows the importance of a congressional enactment giving to the Secretary of Agriculture power to control the importation of biological products intended for the treatment of animals, and to supervise the preparation of such products for interstate commerce, in the same manner that such products for use in human medicine are already under the control of the Public Health and Marine-Hospital Service.

With the progress of medical and veterinary science there is an increasing traffic in vaccines, serums, antitoxins, etc., and there is great danger that without proper control there may be introduced with these remedies the contagion of some disease that would cause havoc among our live stock.

TICK ERADICATION.

Continued progress has been made in exterminating the ticks that spread the infection of Texas fever of cattle in the South. During the fiscal year areas aggregating 13,544 square miles were released from quarantine because of having been freed from the ticks, these areas being located in Virginia, North Carolina, Tennessee, Arkansas, Oklahoma, and California. Since the beginning of the work in 1906 there have been released 71,336 square miles. In connection with this work during the past fiscal year the inspectors of the Bureau of Animal Industry made over 3,000,000 inspections of cattle. The work of tick eradication is being carried on in cooperation with state authorities, and it is the Department's policy to operate only in States and localities where official and public sentiment are favorable. The amount expended by the Department for this work in any State is dependent upon the amount that the state or local authorities are prepared to expend.

The tremendous benefits to be derived from this work become more evident as it progresses. In sections that have been freed from the ticks the farmers are obtaining higher prices for their cattle than can be realized for cattle from below the quarantine line, and they are also raising more and better cattle. At the leading markets to which southern cattle are shipped there is a difference ranging from $2.25 to $5 a head between the prices paid for tick-infested cattle and for cattle of similar grades from the tick-free areas, and more than 1,000,000 southern cattle from the quarantined area are sold annually at these markets, besides animals marketed locally in the South. Taking $3 a head as a conservative average difference, it appears that there is an annual loss of over $3,000,000 on southern cattle shipped to northern markets, not taking into account the losses from the lighter weight and poorer condition of the tick-infested animals or the difference in price on animals marketed in the South. This is only one item in a heavy account of losses chargeable to the tick and which can be entirely overcome by exterminating the pest. The enormous economic value of this work and the possibility of its success are beyond question. It is only a matter of adequate appropriations by the state and federal governments.

SCABIES OF SHEEP AND CATTLE.

The work of eradicating the diseases known as scabies of sheep and cattle, which has been in progress for several years in cooperation with the authorities of a number of Western States, has been continued with good results and the infected territory has been still further reduced. During the fiscal year the States of Kansas, Nebraska, Montana, North Dakota, and South Dakota were released from the quarantine on account of sheep scab, and areas aggregating over 60,000 square miles in North Dakota, Colorado, Oklahoma, Kansas, and New Mexico were released from the quarantine for scabies in cattle. Employees of the Bureau of Animal Industry made 59,762,512 inspections of sheep and 17,656,934 inspections of cattle, and supervised 15,597,823 dippings of sheep and 1,559,477 dippings of cattle. Since the close of the fiscal year it has been found necessary to place a federal quarantine on the State of Kentucky because of the increasing prevalence of sheep scab. Heretofore the quarantine for this disease has been confined to the West, and this is the first time that it has been considered necessary to impose a quarantine east of the Mississippi River.

TUBERCULOSIS.

Under the provision of the appropriation act for the past fiscal year "to enable the Secretary of Agriculture to investigate the prevalence and extent of tuberculosis among dairy cattle in the United States," the tuberculin test was applied to numbers of cattle in several parts of the country by arrangement with state and local authorities. Cattle were tested for interstate shipment to States requiring the tuberculin test as a prerequisite to the admission of dairy and breeding cattle, and assistance was also given to city authorities in testing cows which furnished milk to certain cities. In all, 8,809 cattle were tested, of which 744, or 8.45 per cent, reacted as tuberculous. The proportion of tuberculous cows among those tested which supplied milk to cities was about 13 per cent.

The Bureau of Animal Industry has also endeavored to assist state live-stock sanitary officers in locating centers of tuberculous infection by reporting to these authorities the names and addresses of owners and feeders of cattle and hogs found tuberculous in the meat inspection, and such reports were made to authorities of twenty-eight States during the fiscal year.

HOG CHOLERA.

The Department has continued its efforts to interest state authorities in undertaking the preparation of serum according to the method of Dr. M. Dorset, of the Bureau of Animal Industry, for the prevention of hog cholera, as the manufacture of the serum for the use of hog raisers throughout the country is too great a task for the Department to assume. During the year representatives of fifteen States at the invitation of the Department visited the experimental farm of the Bureau near Ames, Iowa, where they conferred with representatives of the Bureau, and had opportunity to observe and study the methods used. As a result of these conferences and others held during the preceding year at least twenty States have taken up the preparation of the serum to a greater or less extent. The plan is for each State to make provision for the manufacture of the serum for distribution among its citizens on such terms as may be considered proper. Considerable serum has been prepared by state representatives, and 25,000 hogs have been treated with serum from these sources. The results have been so satisfactory that it is expected that the state work will be enlarged where it has already been undertaken and inaugurated in other States where hog raising is an important industry.

RABIES.

Judging by the increasing number of animals sent to the Bureau in order that diagnoses may be made as to whether or not they are affected with rabies, this dangerous disease appears to persist and even to have increased in prevalence during the year, especially in the vicinity of Washington, D. C. Out of 153 animals suspected of being affected and sent in for examination, 104 were found to be rabid, and these had bitten no less than 48 persons, besides a much larger number of animals. As the persons bitten were promptly notified of the diagnosis so that they might take preventive treatment, no deaths of persons are known to have resulted, but considerable anxiety and expense have nevertheless been caused to them and their families. Experience has shown that the strict enforcement of muzzling all dogs for a sufficient period is the most effective means of stamping out the disease, and no improvement may be expected until proper measures are vigorously applied.

NECROBACILLOSIS IN SHEEP.

During the year lip-and-leg ulceration and other forms of an infectious disease of sheep known as necrobacillosis have become quite prevalent in Wyoming and Montana, and the Bureau of Animal Industry has investigated the nature and extent of the disease with a view to combating it. This disease has existed in a mild form for many years and only recently has assumed a virulent form and seriously threatened the sheep industry. Certain portions of Wyoming were found to be so badly infected that soon after the close of the fiscal year they were placed under federal quarantine and shipments of sheep therefrom are permitted only under certain restrictions. Treatment is effective if carefully and thoroughly applied, and it is hoped that by the combined means of treatment and quarantine the infection may be checked and stamped out without spreading to other parts of the country.

BLACKLEG VACCINE, TUBERCULIN, AND MALLEIN.

The preparation and distribution of vaccine for the prevention of blackleg in young cattle, which has been carried on by the Bureau for several years with the result of greatly reducing the losses from this disease, have been continued, about 1,150,000 doses having been sent out to stock owners free of charge during the year.

There were supplied to official veterinarians and health officers during the year over 250,000 doses of tuberculin for the diagnosis of tuberculosis in cattle, and more than 55,000 doses of mallein for the diagnosis of glanders in horses.

TUBERCULOSIS INVESTIGATIONS.

The scientists of the Bureau of Animal Industry have continued their studies of tuberculosis. An investigation of this disease as it simultaneously affected hogs and poultry on an Oregon ranch demonstrated that the transmission of tuberculosis from fowls to swine readily occurs. During the year an article by an American investigator pronouncing tuberculosis in all its forms to be a bacteriemia—indicating that the disease was constantly associated with the presence of numerous tubercle bacilli in the blood—led the Bureau to carry out a series of experiments on this point, which had an important bearing on the meat-inspection regulations; and as a result of these experiments it was shown that while in some forms of the disease the bacilli may in rare instances be present in the blood for short periods of time, tuberculosis, at least in animals, is not characterized by the condition referred to and can not properly be termed a bacteriemia. Experiments made by the Bureau during the year with reference to the sources from which hogs contract tuberculosis indicate that infection occurs much more readily from allowing hogs to feed on the feces of tuberculous cattle than from exposing them to tuberculous hogs or feeding them the milk of tuberculous cows, although the latter is also a common mode of infection. Tests of the duration of life of tubercle bacilli in butter and cheese are still in progress, as are also various investigations in the immunization of cattle against tuberculosis.

TESTS OF SERUMS, ETC.

Under authority of Congress tests have been made of tuberculin, serums, and analogous products sold for the detection, prevention, treatment, or cure of diseases of domestic animals. Two imported preparations advertised and labeled, respectively, as a serum and a vaccine against hog cholera were found to be ineffective for protecting hogs against that disease. A domestic preparation widely advertised as an "antiabortion serum" was found not to be a serum at all, but to consist of a weak solution of carbolic acid. The tuberculins tested during the year were all found to be satisfactory. Several so-called "rat viruses" were also tested, but none were found to contain germs that were reliable agents for killing rats or spreading disease among them.

ANIMAL HUSBANDRY.

BREEDING AND FEEDING.

The Bureau's investigations in animal breeding and feeding have progressed satisfactorily. Carriage horses are being bred in Colorado, Morgan horses in Vermont, Shire and Clydesdale horses in Iowa, range sheep in Wyoming, and milking Shorthorn and Holstein cattle in Minnesota. The experiments in animal nutrition at State College, Pa., and those in beef production in the South have been continued along the same lines as during the previous year and are yielding satisfactory results. In the breeding experiments at the Bureau's experiment station at Bethesda, Md., six zebra-ass hybrids were foaled during the year, three of which died, while the remaining three are vigorous and promising. Extensive experiments involving the use of nearly 4,000 small mammals, to determine certain points regarding inbreeding, heredity, etc., are under way at the station.

CLASSIFICATION FOR AMERICAN CARRIAGE HORSES.

The classification for American carriage horses proposed by the Department, in conjunction with certain breeders' associations, was used at twelve state fairs in 1908, and resulted in some good exhibits. Fourteen fairs of state or national importance offered the classification in 1909. This classification is expected to be of great value to farmers and horse breeders in the development and production of a good type of carriage horses.

POULTRY AND EGG INVESTIGATIONS.

Besides the cooperative experiments in poultry breeding and feeding at the Maine Agricultural Experiment Station, the Bureau has in progress some independent investigations, which are nearing completion, for the comparison of different methods of feeding poultry.

During the year a study was made of the conditions surrounding the production and marketing of eggs, and a report was published pointing out the heavy losses and the means by which they might be overcome. A cold-storage evaporimeter, for measuring and regulating moisture in storage rooms, was devised by a member of the Bureau staff and has been patented by the Department so that it may be used by the public in this country free of royalty.

WORK RELATING TO THE DAIRY INDUSTRY.

SOUTHERN DAIRYING.

The educational work for the development and improvement of the dairy industry in the South has been continued along the same lines as in the previous fiscal year. Records have been kept of 73 herds containing 1,642 cows, enabling the owners to know just what results were being obtained from each cow and to eliminate unprofitable animals. Many of these owners have been induced to use purebred bulls for the improvement of their herds. Assistance has been given in the improvement of the milk supplies of 20 southern cities. Plans have been furnished and advice given for the construction of barns, stables, dairy houses, silos, etc. Agents of the Bureau have spoken at numerous meetings, have given instruction in schools, and have given advice and assistance to individual dairymen and farmers. The organization of dairy associations has been encouraged. The work so far done is proving of great practical benefit. The South has great possibilities for a prosperous dairy industry, but there is need of development of resources and improvement in quality of animals and in methods.

COW-TEST ASSOCIATIONS.

Assistance has been given to state officials in organizing and conducting associations for the purpose of keeping records of dairy herds and cooperating for the mutual advantage and improvement of the members. There are now 27 of these associations organized, with 741 members, owning 11,686 cows, in 9 States.

DAIRY PRODUCTS INVESTIGATIONS.

Investigations and experiments have been carried on to determine various problems with regard to the manufacture of butter and cheese, and the bacteriology and composition of milk. The study of factors influencing undesirable changes in storage butter has yielded important practical results. It has been found that acid in cream causes great changes in the flavor of such butter, and that the troublesome "fishy flavor" occurs only in highly acid butter and sometimes only when it has been overworked. It has been determined that butter with excellent keeping quality can be made of pasteurized sweet cream without the use of a "starter," and this seems to be a remedy for some of the conditions that have caused loss to the butter trade.

Work on the Cheddar, Swiss, Camembert, and Roquefort types of cheese has been continued, and information of practical value to the cheese industry is being developed. A special study has been made of the difficulties encountered in the manufacture of the Camembert type of cheese in the United States. It appears that climatic conditions are unfavorable during the greater part of the year in most of the regions where factories have been located, but that this disadvantage can be overcome by constructing factories in such a manner as to provide proper control of temperature, humidity, and ventilation.

The Bureau has rendered assistance to 159 creameries with a view to remedying difficulties and losses, and it is estimated that in consequence about $250,000 was saved to them during the past year.

IMPROVEMENT OF MILK SUPPLIES.

The Bureau of Animal Industry has carried on an important line of work for the improvement of the milk supplies of various cities. Representatives have been sent on request of local authorities to cooperate with them. Public meetings are often arranged for producers, consumers, physicians, and others, at which addresses are made and the subject of milk improvement is discussed, and sometimes there are competitive exhibitions of milk and cream. The score-card system of inspection is an effective means of improving the sanitary condition of dairies, and the Bureau recommends the use of this system and gives assistance in introducing and applying it. During the year the score-card system was adopted in 64 cities, making the total number now using it 125. Bureau representatives visited 315 dairy farms, located in 18 States, during the year, for the purpose of assisting local inspectors in the use of the score card, and the average score on these farms was 46.42 points on a scale of 100. Reports received on 29,970 dairies show an average score of 52. As a rule the scores are entirely too low, but marked improvement usually follows the inauguration of dairy inspection by the score-card system.

RENOVATED-BUTTER INSPECTION.

The Department is charged by law with the supervision of factories producing renovated or process butter and with the inspection of the materials used and the product turned out. Inspection was carried on at 43 factories during the year, and the product amounted to 47,432,276 pounds, a slight decrease as compared with the previous year.

OTHER DAIRY WORK.

A very practical and helpful feature of the Bureau's work is the designing of various kinds of buildings and the furnishing of drawings and specifications for their construction. During the past fiscal year 2,086 blueprints were sent out.

BUREAU OF PLANT INDUSTRY.

A rapidly growing interest is being shown in this country in what may be termed agricultural readjustment. The shifting and changing of economic conditions due to world-wide influences and the almost complete reversion of old and established agricultural practices and methods due to purely local causes all tend to make the study of crop production and crop adaptation more and more complicated each year.

WORK FOR THE DRY-LAND FARMER.

A striking example of the trend of agricultural development and effort at readjustment is found in the widespread demand for help coming from all that vast territory west of the one hundredth meridian and popularly spoken of as the dry-farming area or the Great Plains region. The nation, the States, and private interests are doing much to attract settlers to this territory, especially to the irrigated portions of it, and in consequence the demand for knowledge on the part of settlers is greater at present than can be supplied.

With a view to aiding those who are seeking to make homes in this region, a number of lines of work have been inaugurated, the more important of which may be briefly reviewed.

EXPERIMENTS TO DETERMINE BASIC FACTS.—To secure knowledge on certain fundamental subjects, investigations have been in progress in the Great Plains area under the supervision of the Office of Dry-Land Agriculture since the spring of 1906. Experimental work is now under way at thirteen stations, located as follows: Judith Basin and Huntley, Mont.; Williston, Dickinson, and Edgeley, N. Dak.; Bellefourche, S. Dak.; North Platte and Scottsbluff, Nebr.; Akron, Colo.; Hays and Garden City, Kans.; and Amarillo and Dalhart, Tex. The work at all these stations is identical. Cropping systems, including continuous cropping with a single crop (such as wheat, corn, oats, or barley), alternate cropping and summer tillage with these same crops, and many crop rotations of two, three, four, five, and six years have been established. Crop sequence, green manuring with both legumes and grasses, time of plowing, depth of plowing, effects of tillage both before and after seeding, and, in short, practically all the various combinations of crop sequence and tillage methods suggested or practiced in this region for the conservation of moisture are being carefully studied.

WORK ON THE RECLAMATION PROJECTS.—Closely affiliated with the foregoing work is that undertaken in cooperation with the Reclamation Service and at the request of the officers of that Service. The Reclamation Service is proceeding with the development of its irrigation projects, and as these are being completed the necessity for advice and assistance along agricultural lines becomes more and more evident. The cooperation undertaken by the Bureau of Plant Industry involves close relations with the experiment stations in the States in which the projects are located. The new regions have peculiar and often unusual agricultural conditions and present problems that are complicated on account of the special crops grown and the limited number of workers at hand.

This work is now in progress at Yuma, Ariz.; Fallon, Nev.; Klamath and Umatilla, Oreg.; Huntley, Mont.; and Bellefourche, S. Dak.

FORAGE CROPS FOR THE DRY SECTIONS.—The forage-crop problems for the dry sections fall within four principal lines: (1) A thorough testing of the most promising crops at hand; (2) new methods of culture for alfalfa and perennial grasses, so that they can be grown with less rainfall; (3) the search for new drought and cold resistant forage crops; and (4) the breeding of new crops for all this section.

In the testing of promising forage crops very encouraging results have been secured in the northern half of the Great Plains region with Canadian field peas. It is necessary to grow this crop alone, as the moisture is not sufficient to support the plants with a mixture of small grains. This crop has succeeded well on all the dry-land farms as far south as Amarillo, Tex.

Another important crop for the dry section is Siberian millet, introduced by the Department in 1899. This plant is proving valuable, on account of its great resistance to drought and its short season. Elaborate tests are being made with the sorghums as a dry-land crop. These plants are found to have great resistance to drought, and the quantity and quality of roughage produced per acre and the sureness of the crop make it of great importance, especially where dependence is placed on stock farming. A special feature is being made of alfalfa culture for this entire section. When broadcasted even the most drought-resistant varieties of alfalfa require about 15 inches of rainfall in Dakota, 18 inches in Nebraska, and 20 inches in Texas. When cultivated in rows, however, the crop succeeds under more arid conditions.

Durum wheat.—The annual production of durum wheat at present, though difficult to determine before taking a census, appears to be at least 50 million bushels, and probably comes nearer to 60 million. The important fact, however, is that a rough estimate shows that nearly two-thirds of this production is in districts so dry ordinarily that other wheats can not be successfully grown, thus having made it possible during the past year to add materially to our wheat crop during the time of scarcity and high prices. Recently two additional interesting facts have developed: (1) The great interest taken by several of the largest mills in the country in the manufacture of patent flour from durum wheat. One of these, a Minneapolis firm, now employs a mill of high capacity exclusively on durum wheat. (2) The rapid increase in the use by foreign countries of our export durum wheat for bread flour. The export now averages considerably over 20 million bushels per annum, of which nearly or quite one-half goes to central and northern Europe, where it is used chiefly for bread.

Dry-land cereals.—Durum wheat has now made its place as a semidry-land crop in the middle Great Plains region and is being rapidly extended into the intermountain dry-land districts. During the past year the work with dry-land cereals has been extended so that at the present time a comprehensive series of experiments is under way at Amarillo and Dalhart, Tex.; Akron, Colo.; Bellefourche and Highmore, S. Dak.; Williston and Dickinson, N. Dak.; Judith Basin, Mont.; Nephi, Utah; and Moro, Oreg.

A very important line of investigation and study has for its object the development of hardy winter varieties of grain crops. During the past year winter wheat was grown at Williston, N. Dak., for the first time, the yield being nearly 40 bushels per acre. At Bellefourche, S. Dak., winter wheat has matured two years in succession, and the yields have been highly satisfactory—usually from 20 to 50 per cent higher than those of the best spring varieties. Extensive tests in the matter of time of seeding winter wheats have brought out the fact more forcibly than ever that the earlier the seed is planted after the 15th of August, provided moisture conditions are at all favorable, the greater will be the percentage of survival.

Tree crops in dry farming.—In portions of the Old World, namely, northern Africa and the southern portion of Asia, where rainfall is deficient and agriculture has been practiced for thousands of years, great dependence is placed on tree crops. In these older countries the fact has been clearly brought out that deep or wide rooted trees are able to stand drought much better than shallow-rooted annual crops. It must be remembered that trees produce not only fruits and nuts, but also rough and concentrated stock food, oils, drugs, and various other industrial products. One of the most striking examples of dry-land agriculture which has yet been brought into prominence is olive growing in the semiarid regions of northern Africa. Here are found vast orchards of olive trees producing good crops year after year in regions where the rainfall often falls below 10 inches for years at a stretch. The system of culture in use there dates back to times of antiquity, when this part of Africa was controlled by the Romans.

With a view to introducing similar industries into the southwestern portion of this country, special studies have been conducted on the behavior of olive orchards in our own dry region where either through the failure of irrigation systems or for some other reason the trees have been deprived of their usual water supply. It has been found that the olive is remarkably resistant to drought, and while other fruit trees have died it has remained alive and borne crops of fruit under very trying conditions. Other important tree crops, such as the date, have been introduced, and studies are under way to determine what can be accomplished in securing trees which will produce stock food and other products useful to the farmer.

PROGRESS IN PLANT AND SEED INTRODUCTION.

The several new types of cold and drought resistant alfalfas and other forage crops secured by Prof. N. E. Hansen and referred to in my last report are under test at a number of stations.

Of the new things recently brought from China, our experts are watching with particular interest the behavior of the wild peach, employed extensively in China as a grafting stock in dry sections for the apricot, peach, and almond, and possibly for the cherry and plum. A stock of this kind would be very valuable in the southwestern dry portions of the country, and the remarkable growth of this peach in these regions has already attracted considerable attention.

Among other new introductions a seedless, nonastringent persimmon has made promising growth at various places throughout the South; also a large-fruited, dry-land Chinese date, which has been grafted successfully and seems to promise a new dried-fruit industry.

The Chinese pistache tree is another introduction which is not only promising as a shade tree for the Southwest, but is the hardiest of all pistaches and a promising stock for the important pistache nut of commerce. Large quantities of this pistache nut are now imported, and it is hoped eventually to have this industry taken care of in our own country.

So great has been the demand for new plants and new crops, especially for the cold northwestern portions of the country, that Mr. Frank N. Meyer, who returned a year ago from a three years' exploration trip through portions of Asia, has again been sent out with instructions to explore the dry semidesert areas which border on Chinese Turkestan, where there are forests of wild apples, pears, grapes, and other fruits. It is also planned to have Mr. Meyer get from the high altitude of the Tien Shan Mountains, in western China, types of early-ripening cereals. He will also secure certain leguminous forage crops adapted to cultivation and range improvement west of the Mississippi River.

An interesting development during the year has come in connection with the discovery by Mr. Aaron Aaronsohn, of Hefia, Palestine, of a very interesting wild wheat which grows on the stony mountain slopes and in the clefts of the rocks in the driest portion of Mount Hermon, in eastern Palestine. This wheat grows over a wide territory and is found at altitudes ranging from several hundred feet below sea level to 6,000 feet above, near the borders of snow fields. It is claimed that this wheat is the progenitor of our modern grain and may prove valuable as a stock for breeding strains of wheat adapted to cultivation in the dry, rocky soils of this country which at present are not considered fit for wheat culture. Arrangements have been made for securing this wheat for limited distribution to plant breeders throughout the country.

LEGUMES FOR THE SOUTH.—Special attention has been given to securing leguminous crops for the Southern States in order to make possible greater opportunities in diversification. The farther south we proceed the more limited becomes the number of leguminous pasture or forage crops that can be grown. In Florida the velvet bean has long been one of the important annual legumes. Recent studies have resulted in finding no less than 14 related species, mostly from southern Asia. One of these, the Lyon bean, mentioned in a previous report, is being grown throughout Florida this year. It is decidedly more productive in pods and seeds than the ordinary velvet bean and seems certain to replace it to a large extent. Another species, the Yokohama bean from Japan, is the earliest sort yet found, maturing in about one hundred days, and is very prolific. This particular bean gives evidence of extending the range of this important crop.

PROGRESS IN GRAIN INVESTIGATIONS.

WORK WITH WHEATS AND OTHER SMALL GRAINS.—Special studies have been made with a view to improving the varieties of wheat and the methods of growing them in the principal grain-producing sections. It will not be practicable to give an estimate of the production of durum wheat until after the next census, but the total for the season of 1909 will probably be not less than 50 million bushels. So rapid has been the spread of this type of wheat that the care and attention necessary to maintain the highest standards in the quality of the grain have not been given. It is important that careful study shall be given to this matter, as the growing of the grain from impure seed or in localities where the climate is not favorable may act detrimentally to the crop as a whole.

Special work has been conducted in the development of other grains, notably varieties of winter oats and winter barley. The further use of these crops, especially in the South, is much to be desired, offering opportunities for the production of stock foods, through the grain, and also of winter pasture.

Considerable progress has been made in the work of improving American barleys adapted to the principal barley-growing sections of the Northwest. The factors of difference between high and low grade barleys have been studied in a new way—the internal structure of the grain itself—and discoveries have been made that furnish a more scientific basis for the cross-breeding and selection work which has been inaugurated.

During the year some systematic work on rice has been inaugurated, stations having been established in South Carolina, Louisiana, and California, and at one or two other points. In South Carolina the principal object of the work has been to secure varieties resistant to blight, or blast, and to obtain information regarding improved methods of culture. In Louisiana cooperative experiments have been inaugurated, having for their object the improvement of varieties in use, the introduction of new varieties, the improvement of cultural methods, etc. This work is being carried on jointly with the state experiment station and with the rice planters of Louisiana. In California some preliminary work has been inaugurated to determine the practicability of rice production in that State.

Work on corn.—During the past year the amount of interest shown throughout the United States in all phases of corn work was many times greater than in any previous season. The state experiment stations are now doing a great deal in the matter of encouraging better methods of growing and breeding corn, and the work inaugurated and carried on by the Department is in general line with these studies. It is not the purpose of the Department or the state stations to produce seed corn for farmers, but rather to determine and verify by a sufficient number of experiments and demonstrations the best methods for them to follow in the production of their seed. Particular attention has been given during the year to the breeding of corns for the South and in conducting tests and demonstrations for the purpose of determining the best methods of increasing yields.

Some interesting facts have been developed regarding the effect of different methods of conserving soil moisture on the yield of the grain. In the South, where summer droughts are likely to occur, the practice of planting corn in furrows from 4 to 6 inches below the level, which has been followed so long, has been found to be based upon sound principles, and by actual tests it has been shown that corn grown in this way has yielded from 4 to 5 bushels more per acre than where level cultivation was practiced. The presence of organic matter in the soil is another important factor in increasing the yields. In a number of instances heavy applications of fertilizers, as much as 1,400 pounds to the acre, have not increased the yield as much as a moderate amount of decaying vegetable matter turned under before the corn was planted.

PROBLEMS IN PLANT PATHOLOGY AND RELATED SUBJECTS.

As usual, the lines of work in the study of plant diseases and the means of controlling them have been many and varied. The investigational features have been advanced, but special stress has been laid upon field tests and demonstrations. During the year studies were conducted in the laboratories on several diseases of the white potato, diseases of sweet corn, crown-gall and other diseases of fruits, a serious bud-rot disease of the cocoanut, and on rice blast and other diseases of rice. During the year the usual efforts have been put forth to augment the pathological collections and to extend the inspection work necessary in connection with the importation, distribution, and handling of the large number of living plants and seeds brought in.

With a view to increasing the efficiency of the inspection work, a special greenhouse is being prepared for this purpose, and a plan is being perfected whereby, through the cooperation of other bureaus in the Department, it is hoped the danger of introducing diseases or insects will be largely overcome. During the year inspections have been made of more than 150,000 plants sent out from the Department greenhouses and from the various offices of the Bureau.

Important advances have been made during the year in the treatment of fruit diseases. For twenty years the efforts of pathologists have been largely devoted to studies of diseases, comparatively little attention being paid to the improvement of the fungicides used. The main reliance has been upon various copper compounds. Recently these have been found to cause serious injury to certain fruits, and it was highly important that some effort be made to determine the cause of this injury, else spraying would have to be abandoned. Very decided progress has been made in this work by the discovery during the year of a number of what promise to be new and useful fungicides. Apples sprayed with these preparations show remarkably high coloration and freedom from all sorts of spots, rots, and other discolorations due to disease.

Studies in forest pathology.—Investigations of the diseases of forest, shade, and ornamental trees and shrubs are conducted in cooperation with the Forest Service. One of the most important diseases studied during the year is that affecting the chestnut. This trouble has spread south to Virginia, west at least to central Pennsylvania, and north to Rhode Island. Where the disease is already established nothing can save the trees. General quarantine methods conscientiously applied would probably check the advance of the malady into new localities. Experiments show conclusively that under orchard conditions the disease can be controlled by a definite pruning and cutting-out system.

Another very serious disease of white pine was called to the attention of the Department during the year and has been made the subject of study. This is caused by one of the rusts and was introduced from Europe into Vermont, New Hampshire, Massachusetts, Connecticut, New York, and Pennsylvania. In many parts of Europe the rust prevents the growing of white pine, and there is no reason for assuming that it would be less serious in America if once established. Efforts have been made to keep the disease from again being imported and to call the attention of the growers of white pine to the necessity for immediate action as soon as the disease is discovered.

Soil bacteriology and water purification.—The distribution of pure cultures of nodule-forming bacteria for inoculating legumes has been continued. Perhaps the most interesting feature of the results reported is the benefit due to the pure-culture inoculations where leguminous crops are planted in regions naturally supplied with the proper bacteria. Either the natural forms of the organism are less vigorous or they are not present in sufficient numbers to produce the best results. Cooperative studies are under way in a number of places with special reference to bacterial development and nitrification in soils.

DRUG-PLANT INVESTIGATIONS AND STUDIES OF POISONOUS PLANTS.

Drug-plant investigations.—The work on drug plants and drug-plant crops has covered investigations and studies on camphor, work in connection with the growing of various types of red peppers, investigations of hops, studies of tannin plants, studies bearing on various changes in lemons due to methods of handling, studies of perfumery plants, and tea culture. The outlook for the camphor industry in this country continues bright, in spite of the fact that the price of imported camphor has fallen from the abnormally high figure which was quoted when the work was begun. Private capital has in large part relieved the Department of further work with this crop, with the exception of certain studies having for their object the determination of questions bearing on the importance of the selection of stock for propagation, with a view to increasing the yield of camphor.

The hop work has had for its object the study of individual plants with reference to their yield and quality, in the hope of improving the character of the hop output. Studies of the relation of hop constituents to flavor and other important properties have been continued.

The cooperative tea work is still confined to South Carolina, the small experiments at Pierce, Tex., having been discontinued because of the unfitness of that situation for the work. The crop for the past season in Doctor Shepard's gardens has been excellent and will aggregate about 12,000 pounds of first-class tea. The future of the industry in this country will depend in part upon the elimination of costly labor processes by the development of suitable machinery for handling the crop at all stages. At present the pruning and picking are hand processes. During the year tea-pruning machinery has been devised and tested, with promising results, and it seems probable that next year it will be feasible to do all the pruning by power machinery, thus eliminating one of the great items of hand labor.

Studies of poisonous plants.—Studies of poisonous plants during the year have been confined to various phases of the loco work, studies of larkspur poisoning, cooperation in the National Forests to prevent injury to stock through poisonous plants, and some special investigations of Indian corn in its relation to the pellagra disease.

Studies of larkspur poisoning have been continued. This is one of the most destructive factors which the stockmen in certain parts of the country are called upon to meet. A field station has been established at Mount Carbon, Colo., where during the past year investigations have been carried on with the various forms of larkspur and other poisonous plants which occur in the flora of that region. Cooperative work with the Forest Service has led to an expert of the Bureau of Plant Industry traveling through certain of the forests for the purpose of pointing out areas dangerous to stock and to recommend in some cases a change of location of trails, so that these poisonous areas can be avoided. In some cases it has been possible to avoid such areas by means of drift fences and of fences inclosing small areas which were especially dangerous. In this way much valuable aid was given to the stock interests.

TOBACCO INVESTIGATIONS.

During the past year the tobacco work has been conducted in the States of Massachusetts, Connecticut, New York, Ohio, Kentucky, Maryland, Virginia, North Carolina, Florida, Georgia, Alabama, and Texas, and has dealt with improved methods of growing, curing, and handling the crop, this work including fertilizer and crop-rotation experiments, breeding and seed selection, laboratory studies on the quality as affected by composition, and methods of combating important diseases.

After several years of laboratory and field experiment a simple and comparatively inexpensive method of introducing artificial heat into the curing shed has been devised, and it is believed that this method, with possibly some further minor modifications, will provide an effective means of combating pole sweat and other troubles during the progress of the curing. In New York the fertilizer tests have demonstrated to both the grower and the buyer that the yield and quality of the product can be economically improved by the use of the formulas recommended. The growers are also being taught the value of winter cover crops for their tobacco lands.

In Florida and Georgia it has been found that the most effective method of controlling the troublesome nematode or root knot of tobacco, and thereby mitigating the damage from the Granville wilt, consists in thoroughly clean cultivation in the late summer and early fall, keeping the grass and weeds down, and occasionally stirring the soil throughout the winter.

SUGAR-BEET STUDIES.

The work on sugar beets has been continued along lines similar to those previously pointed out. The encouragement of sugar-beet seed production is being continued. Through work at a number of stations valuable hybridized strains of beet seed are being produced, and some of them are already in the hands of commercial growers, who are offering American-grown seed of high quality for sale. The work on the production of single-germ seed is being conducted with promising results. It is hoped, by securing special strains of beet seed, to reduce the cost of growing sugar beets and to extend the industry into certain sections where the soil and climatic conditions are at present unfavorable for the best development of the strains now generally used. In all the work involving seed production, methods of siloing seed beets are receiving a great deal of attention. Further work has been continued in the matter of improving cultural methods in connection with the growing of this crop. Preparation of the seed bed, planting the seed, care of the beets, and harvesting are all under experimentation and demonstration. Crop rotation is another important matter being considered in connection with the growing of the beet. New areas not previously devoted to the growing of sugar beets are being tested from year to year, with a view to the extension of the industry. These tests are made as far as possible under field conditions, and if the results are promising the tests are repeated for several years in succession. By this work there have been located a number of areas that are very promising for the extension of the sugar-beet industry. In conducting these experiments consideration is given as far as possible to the other conditions necessary in sugar-beet production, such as the presence of lime, rock, water, etc.

FIBER INVESTIGATIONS.

Many plant fibers and many questions pertaining to fiber production have been investigated during the past year, but attention has been directed especially to hemp and flax, which, aside from cotton, are regarded as the most promising fiber-producing plants for this country.

Hemp.—The preliminary experiments in the cultivation of hemp in Wisconsin in 1908, in cooperation with the state experiment station, gave very encouraging results not only in the destruction of Canada thistle and quack grass but also in the production of fiber. In spite of adverse weather conditions for retting, more than 9,000 pounds of fiber were obtained from 6 acres. This average yield of a little more than 1,500 pounds per acre compares very favorably with the average of 1,000 pounds per acre on the best farms of Kentucky. The hemp was dew retted on the land where it grew, as is the common practice in this country, returning to the soil most of the fertilizing elements taken up in its growth.

Machine brakes for preparing hemp fiber are replacing the slow hand brakes, and in some instances, at least, they are doing not only more work but much better work. The satisfactory results with American hemp binder twine, which has been placed on the market during the last two years, give promise of an extensive market for fiber of medium grades suitable for this purpose.

Flax.—Flax cultivated for the production of fiber in this country is grown from seed imported from Belgium, Holland, or Russia. Seed, as well as fiber, is obtained from the crop, but without selection the seed has deteriorated so that it does not produce good crops after the second or third generation. Improved varieties of flax for seed production have been developed by careful selection of the experiment stations in Minnesota and North Dakota, but there has been little demand in those States for flax grown primarily for fiber with seed as a by-product. Work has now been undertaken by this Department with a view to the development of improved American varieties of fiber types of flax, and the initial selections have been made in the fiber-flax fields of eastern Michigan.

FRUIT MARKETING, TRANSPORTATION, AND STORAGE INVESTIGATIONS.

The work in connection with the extension of fruit markets has been considerably enlarged during the year. It includes an investigation of cold storage, of transportation, and of the methods of handling the fruit in preparation for market. There have been a large number of requests from fruit growers' organizations, shippers, and transportation companies for an extension of this work to different parts of the country.

Lemon-handling problems.—The California lemon crop amounted approximately to 6,200 carloads in the year ended October 31, 1909. The imports from Italy were equivalent to over 5,000 carloads in the fiscal year 1909. The American lemon as a crop is superior in grade and equal in quality to the European fruit. The industry is increasing steadily in volume. So far as the fruit is concerned the extension of the American lemon trade depends on having lemons that can be laid down in all of the markets of the country in sound condition. In response to the requests of the California growers and shippers, the Department, in cooperation with the leading growers and organizations, is determining the factors that govern the keeping quality of the California lemons. The results so far obtained show that the American lemon has splendid keeping quality and that the fruit may be shipped in sound condition throughout the United States if it is handled without bruising in the fields and curing houses. As a result of the work already done important changes are taking place in the handling of the crop in California.

California grape-shipping problems.—The shipments of table grapes from California approximate 4,000 carloads. These shipments may be doubled or even trebled when the young vineyards come into bearing. The imports of grapes equaled over 1,000,000 cubic feet in 1909, or the equivalent of about 1,500 carloads. At present the California crop has to be marketed in sixty days. It will be helpful and practically necessary to extend the marketing season over a greater length of time when the young vineyards come into bearing. An investigation has been commenced to determine the relation of the methods of handling and shipping the grape to the losses that occur in transit, and to devise methods under which the marketing season can be lengthened and the marketing area widened. This work has the hearty cooperation of the growers, shippers, and transportation companies, and has already improved the methods in the industry.

Florida orange work.—The Florida orange handling and transportation work was continued during the shipping season. The results have been as clear cut as those which have revolutionized the methods of handling and shipping the oranges in California. They show that the losses in transit are largely due to the rough handling of the fruit in preparing it for shipment. In California the work has been worth at least $1,000,000 a year to the industry. In Florida it has been much less effective, though the methods are changing slowly and the old packing houses are being remodeled.

Improvement in fruit transportation.—During the year a more extensive study has been made of the effect of cooling perishable fruits to a temperature of about 40° F. before shipment. At present fruit, unlike meat products, is loaded for shipment in a warm condition. The temperature of the fruit is reduced slowly in transit, but not fast enough to prevent the rapid ripening of some of the fruits and the decay of others. The preliminary work along this line had shown that fruit that ripens can be marketed over wider areas when cooled before shipment, and that it can be allowed to remain on the tree until it reaches a higher quality before it needs to be harvested.

It has not been possible to conduct these investigations satisfactorily, as cold-storage facilities were usually lacking where needed. A refrigerating plant has been designed and constructed in a specially built car to meet this need. The plant can be moved to any part of the country. It can be used in the experimental work to refrigerate fruit in a warehouse alongside or in a car by blowing cold air from the coil room of the plant to the warehouse room or to the car containing the fruit. The plant has been located at Riverside, Cal., where a study has been made of the effect of cooling oranges at different temperatures and with different degrees of rapidity. Later in the season it will be used in the grape-shipping investigations in central California.

Progress in grape investigations.—The viticultural investigations on the Pacific coast to determine the adaptability of resistant stocks to soils and the congeniality of the leading varieties to such stocks is progressing satisfactorily. The cooperative vineyards in California now contain 415 vinifera and 277 resistant varieties, with 271 vinifera varieties grafted on resistant stocks. The study of the Rotundifolia type of grape in the South is progressing as rapidly as the funds available permit.

Vegetable testing.—The results of the year's work in testing some 1,200 so-called distinct varieties of vegetables have shown that in a great many cases seedsmen send out under varying varietal names stocks whose only difference is the degree to which they are uniformly of the same varietal character and that the use of different varietal names to distinguish what are in reality simply different grades or strains of the same sort is a very common practice of even our best and most reliable seed firms.

Cooperative marketing of crops.—One of the most promising tendencies of the day is the spirit of cooperation and mutual helpfulness which is beginning to manifest itself among the producers of truck crops. The successful organization and working of cooperative marketing companies or exchanges by farmers have proved the possibility as well as the desirability of a system of marketing which shall have headquarters at the point of production. Products can be distributed more economically and more satisfactorily to the consumer from the point of production than from a city distributing center. The work of one of these cooperative organizations has come under the notice of the Department during the past year. Of an aggregate business of $2,500,000, this organization was able to handle 90 per cent of its work from a central office in the growing district on an f. o. b. shipping-point basis. The prices received were equal to New York and Philadelphia prices in all cases. The net results of these operations were the elimination of losses which inevitably result from consignment, practically cash transactions for all sales, and the saving of transportation from the field to the center of distribution in one of the large cities, which in this case added $150,000 to the farmers' profits on the year's business.

DOMESTICATION OF THE BLUEBERRY.

Experiments in the cultivation of the blueberry have been continued. A report on these experiments, now in preparation, will contain the detailed information needed by private experimenters to enable them to handle these peculiar plants with success. The failure of the experiments with blueberries at some of the agricultural experiment stations has been due chiefly to the fact that it was attempted to grow these plants in the ordinary fertile garden soil suited to other small fruits. From the experiments now made it appears that the blueberry not only prefers an acid soil but will not thrive in any other than an acid soil. In the choicest type of agricultural land, mellow, well drained, well aerated, fertile, and of neutral or slightly alkaline reaction, so that the nitrifying bacteria perform their work with the highest degree of efficiency, the blueberry either dies or maintains a feeble and fruitless existence; but when grown in a raw, acid soil, such as is commonly found in swamps, or on moist mountain slopes, or on the surface of sandy oak or pine lands, the blueberry takes on a luxuriant growth, a fact that is remarkable when one considers that these same soils are one of the poorest types for ordinary agricultural purposes, and that because of their acidity the growth of the nitrifying bacteria, so essential to most crops, is very greatly reduced or altogether inhibited.

CONGRESSIONAL SEED DISTRIBUTION.

The distribution of seeds and plants on Congressional order was continued during the past year along the same general lines as previously. Owing to the higher price of vegetable seeds, the quotas assigned to each Member of Congress were slightly smaller than in former years. The packeting, assembling, and mailing of the vegetable and flower seeds were carried out satisfactorily under contract, as formerly. Particular attention has been devoted to the development of improved methods of cleaning the seed obtained for Congressional distribution, and its quality has been greatly improved thereby. Another line of work connected with the seed distribution which should be mentioned is the effort to bring about the home production of Dutch bulbs in sufficient quantity to build up a new industry. There are sections of the Pacific coast region which seem well suited to the production of these bulbs, and experiments are under way to determine whether their cultivation can be carried out on a successful commercial basis.

PURE-SEED INVESTIGATIONS.

The seed-testing laboratories of the Bureau have continued their efforts in the interest of pure seed for the farmer. Three branch laboratories are now in operation, in cooperation with the experiment stations of Nebraska, Missouri, and Oregon. At these laboratories, as well as at the main laboratory in Washington, many hundreds of samples of seed submitted by farmers and seedsmen are being tested for the presence of adulterants, as well as for purity and germination, and the results of these tests reported.

In accordance with the authority granted by Congress, samples of seed of forage crops have been collected and examined, purchases being made of those showing signs of adulteration. This work has been conducted along lines followed in the past, the names of firms whose seeds are found to be adulterated being published. It is very gratifying to state that the practice of seed adulteration has in this manner been practically stopped, save in the cases of orchard grass and Kentucky bluegrass, and quite materially reduced even in these cases.

An educational movement for the purpose of encouraging greater interest in good seed has been carried on by means of lectures and lantern-slide demonstrations at farmers' institutes, several weeks having been spent in this work. During the past year opportunities have been afforded persons interested in pure-seed work to study seeds and approved methods of seed testing in the main laboratory at Washington. Representatives from several prominent seed houses preparing to do their own seed testing were among the number, and as a result several have purchased apparatus preparatory to fitting up laboratories in their own establishments. Hundreds of authentic samples of common weed and economic seeds, put up in vials labeled with their common and scientific names and packed in herbarium trays, have been distributed, to be used for reference, thus enabling individuals to become familiar with the more common economic seeds and their impurities.

COTTON STANDARDIZATION.

During the past year substantial progress has been made toward the establishment of official grades of American cotton, in accordance with law. In February, 1909, a committee of representative cotton men, called together in Washington, unanimously recommended the adoption of official cotton grades and submitted a set of types which in its opinion fairly represented the grades sought to be established. Preparations for the promulgation of these grades have been going steadily forward, and it is expected during the present year to place sets with the principal associations, organizations, exchanges, and agricultural colleges most interested in cotton. It is also hoped that the work of more generally distributing the grades by sale may soon be undertaken.

The work of investigating the condition of American cargoes of grain on arrival at European ports during the past three seasons, as mentioned in the last report, has been brought to a conclusion, and the data bearing upon the important phases of that work, together with other information collected which is of value to the grain interests, are now being prepared for publication.

The results of the grain-standardization work are being manifested in many ways, principally in an increased activity among influential grain interests toward bringing about more satisfactory conditions with relation to grain-inspection practices, with the noticeably desirable result that the grain trade generally is beginning to realize the seriousness of the question. The introduction into the grain business by the Department of Agriculture of a quick method for testing moisture in grain has proved an important factor in causing greater care to be taken of corn on the farm, as it has been instrumental in educating the grain buyer and handler with regard to the moisture content and its effect upon grain values. This has no doubt been an active influence in the disappearance of the open-rail corncrib or pen from the corn belt. Railroad and elevator companies are becoming interested in the work, because of the close relation of some of its phases to a subject of much interest to them, known as "natural shrinkage" in commercial grain.

SPECIAL PLANT INTRODUCTION AND TESTING GARDENS.

The special field gardens of the Bureau have made good progress during the past year and have proved a valuable aid to the various lines of investigation conducted throughout the country. The Plant Introduction Garden at Chico, Cal., has been improved during the year, and arrangements have been made to undertake definite work at that point in the extensive propagation of the various seeds and plants secured through introduction and otherwise. The services of a plant breeder of wide experience have been secured for this work.

The South Texas Garden, at Brownsville, has been further developed during the past year and has increased its efficiency in aiding the settlers in the surrounding country. An investigation of the possibilities of southern Texas for citrus-fruit culture was made during the year and the results published. The Subtropical Garden, at Miami, Fla., has been practically discontinued, the greater portion of its work having been turned over to the local authorities of Miami under a cooperative arrangement. This plan will enable the Department to direct its energies in southern Florida to a general series of field experiments and investigations, thus affording greater aid to the region as a whole.

FARM MANAGEMENT.

The Bureau has continued to study the methods and practices on the most successful farms throughout the country, and a great quantity of valuable information has been acquired, which is being put to practical use by way of demonstrations, experiments, etc. In addition to the general lines of farm-management work, the Bureau is making special studies of farm practice in the use of fertilizers; the field management of weeds and their relation to tillage practices; the production, curing, and marketing of hay; the economic handling of pastures; and the production of strains of cassava for the South that will reproduce true to seed. Three such strains of cassava have been produced and are now being propagated on a considerable scale. By propagating this crop from seed instead of from cuttings the region to which it is adapted can be greatly extended, especially in those sections of the Gulf coast where corn does poorly.

USE OF LEGUMES IN THE SOUTH.—Our work during the past few years in encouraging the use of leguminous crops in suitable rotations for the rebuilding of exhausted soils is showing marked results. As compared with five years ago, cowpeas are more extensively grown all over the South, and improved methods of saving the seed through the use of machinery have become established in various localities, particularly in eastern Tennessee and southeastern Missouri. Other leguminous crops have become established and are being used in rotations in scattered sections. The extended use of vetch is pronounced in North Carolina and South Carolina and parts of Georgia and Louisiana, while bur clover prevails in northern Alabama, crimson clover in Virginia, Japan clover in Louisiana, Arkansas, and Mississippi, and alfalfa in the black, waxy, and alluvial soils of all the Southern States.

Farm practice in producing forage for stock.—Our work in the West and also in New England has been directed more especially toward improved methods in the use of suitable forage crops for sheep and hogs and the devising of proper cropping systems in stock production. The sheep industry in the New England States, for some time thought decadent, is proving profitable under capable direction and is a type of farming well suited to much of the rough pasture land of those States. There is also a demand for cheap, light-weight, native pork in New England, and the value of such pasture crops as rape, clover, and peas is being brought to the attention of the farmers.

Crops for cut-over and stump lands.—Observations of the sandy jack-pine cut-over lands in Michigan, Wisconsin, and Minnesota have been continued and work has been begun in the growing of hairy vetch as a seed and forage crop suitable for these lands. Large quantities of hairy vetch are now grown throughout the Atlantic Coast and Southern States as a soil-improving, forage, and winter cover crop, the seed for which is nearly all imported. The light, sandy soils of the North promise to be well adapted to this crop. Another important problem in some of the central-northern States, where lumbering operations have been extensive, is the successful handling of stump lands. The value of various stumping machines and equipment, as well as of dynamite and certain other powerful explosives, in the economic clearing of these lands for settlement is being studied.

Cost of producing farm crops.—The cost of producing farm crops and the time necessary to perform certain farm operations are being studied as a basis for making farm plans. In this work the Bureau is cooperating with successful farmers in different sections of the country, who send in daily reports of work done. Bookkeeping, while a vital part of successful business enterprises, has never been popular on the farm because of its complexity. A simple system of farm accounts and supplementary records has been worked out and tried on a number of farms during the past year, with most promising results. The study of farm machinery and of the relation of machinery to farm management and farm profits has also been studied.

Work with the prickly pear.—In southern Texas the prickly pear has proved a valuable farm forage crop for cattle, sheep, and swine and the best insurance against stock famine that can be grown in that section. It has been proved that the prickly pear, well cultivated, will seldom, if ever, suffer from drought in southern Texas, while the uncultivated cactus often does. By breeding the least spiny, most prolific, and hardiest native pear with the spineless cultivated forms it is hoped to secure a prolific spineless form that will be hardy in that section; but until this is accomplished the spiny native pears should be used. About 10 tons of cuttings of the spineless varieties of pear were distributed during the year to settlers in the less frosty sections of the country, where there is a probability of their successful growth.

FARMERS' COOPERATIVE DEMONSTRATION WORK.

The demonstration work among southern farmers has made rapid strides during the past year. Any observer of farm crops in the United States has noticed that a few farmers secure a good yield almost every year regardless of seasons or pests, while the great majority of farmers make only moderate returns the best seasons and between these secure only partial yields or have total failures. The advent of the boll weevil in the cotton States accentuated this situation and enormously multiplied the failures until a total wreckage of that great fiber industry was threatened. Primarily to meet this condition the Farmers' Cooperative Demonstration Work was inaugurated upon an extensive scale by the Bureau of Plant Industry in January, 1904.

DEVELOPMENT OF THE WORK.—If the increasing demand for the work is a measure of its value, then it is certainly accomplishing the objects for which it was inaugurated. It has increased in the past six years from 1 field agent to 362, and from 1 farm under supervision to more than 60,000 farms, including those classed as cooperating. The work is now being conducted more or less extensively in twelve States, and has been influential in securing to a considerable extent the addition of humus to the soil and an improvement of soil conditions, a better preparation of the soil for crops, the use of better varieties of cotton and corn, almost universal attention to seed selection, more intensive cultivation, the better storing of crops, the production upon each farm of the foods necessary for the support of the families and teams working the farm, more pastures and meadows, more and better teams and implements, more live stock, great improvement in farm and home conditions, more months of schooling, and better rural conditions.

EXTENSION OF THE WORK THROUGH VOLUNTARY CONTRIBUTIONS.—Agencies other than those of the State have very materially aided the rapid extension of the work. In a large number of counties in Mississippi, North Carolina, Texas, and other States the people themselves have made considerable contributions to secure additional time and service from a local agent of the Department. In other words, when the Department funds were only sufficient to employ a man a part of the time the county supplemented the amount and secured the full services of the agent.

BOYS' CORN CLUBS.—In the boys' corn clubs of the Southern States there were enrolled the past year 10,543 boys, who were required to work a plat of ground upon their fathers' farms under instructions from the Department. These demonstrations served a double purpose, practical education and encouragement to the boy and a valuable lesson to the farmer, as the yield of corn on the boys' plats was generally many-fold the average product of the farm. Greater interest was manifested in this work by the citizens of the county than in demonstration work among adult farmers. Ten thousand dollars in prizes were contributed by public-spirited citizens to encourage boys' corn clubs during the past season.

FOREST SERVICE.

The Forest Service manages a great producing property. It carries on investigations that will enable private property to be put to better use. It seeks to diffuse and get into practice the knowledge which its scientific studies yield. But of first importance is its work in caring for the National Forests.

THE NATIONAL FORESTS AS PUBLIC PROPERTY.

All told, the proclaimed boundaries of the National Forests now include nearly 195 million acres of land. This is nearly 27 million acres more than a year ago. Of the gross area, however, much belongs to States and private persons. Through grants by Congress and the patenting of claims under the land laws there has been alienated about 16 million acres. Many other claims are pending. Altogether the actual National Forest property, exclusive of all alienations and unpatented but valid claims already pending, comprises 147 million acres of land in the continental United States, with 26 million acres more in Alaska. This vast property belongs to all the citizens of the United States jointly, and is in my charge to manage for their benefit, just as the holdings of any private corporation belong to the shareholders and are managed for them by the corporation's officers.

The administration and protection of the National Forests cost last year less than $3,000,000, with an additional $500,000 spent on improvements. The cash receipts for the year were not far from $1,800,000.

Of the three principal resources of the Forests—water, forage, and timber—the timber is for the time being the least developed. Receipts are no measure of the present use made of all three resources. Explanation of what the public is getting out of its property—an intelligible statement, in other words, of what truly constitutes the credit side of the National Forest income account—requires that these products be considered separately.

THE WATER YIELD OF THE FORESTS.

From the nature of the case the value of the Forests as regulators of stream flow and conservers of the supply available for irrigation, power, and navigation defies statement in terms of dollars and cents. But there is no important stream in the West whose waters are not through the dry season drawn mainly from the National Forests. The overwhelming weight of common experience as of scientific observation recognizes the important service of the forest in preventing erosion and equalizing the flow of water from mountainous regions. Without the water protection secured by the National Forests, this greatest of western resources would grow progressively more inconstant and less valuable.

But the Forest Service is doing more than merely safeguarding present water supplies. Partly as a result of the work of civilized man, partly as a result of purely natural causes, the forests of the West are almost everywhere not in the best condition. Destructive lumbering, unregulated grazing, insect damage, and fire have all played their part, but fire has been by far the most harmful. Seldom can any extent of forest be found without old burns, or a mountain range that is not scarred by great stretches of unwooded or half-wooded slope. From as far back as the trees bear record, fires have raged in the western timber. During last year the principal cause of fires in the National Forests was railroad locomotives; the second, lightning. Man and nature have both sent the fire to thin or sweep away the protective cover of the mountain sides. But the fires are no longer allowed to burn until they go out or are put out by rain. Vigilant protection is now given the Forests, and this will mean the steady improvement of water conditions in the West.

Regulated grazing also makes for better water conditions. In the Tonto Forest, for example, sheep grazing on certain parts of the Salt River watershed has been found by the Reclamation Service to be injurious to the interests of the Salt River project, and accordingly the Forest Service, after fair notice to the stockmen who have been using these parts of the range, will close them to sheep. This, however, is an extreme case. Usually stock under proper regulations can utilize the forage crop without harm to the water supply, and are permitted to do so under the present system.

THE FORAGE YIELD OF THE FORESTS.

The use of the forage crop of the Forests brings a profit to the public partly through the payment of charges by private individuals for the grazing privilege, but chiefly, as does the water, through the promotion of the general welfare. Though the grazing charges brought into the Treasury of the United States over $1,000,000 last year, the administrative expense of regulating the use of the range cost the Government nearly as much. In truth, grazing fees are fixed with a view primarily to meeting the expense of regulation, not to raise revenue. The charge for the grazing privilege was far lower than that usually paid by stockmen to owners of private land. Were the National Forests the property of an ordinary corporation, concerned not with the interest of all the people but only with that of a limited body of shareholders, grazing might have furnished at least twice as great an income as it has furnished. In other words, had the stockmen paid the full market value of their use of the National Forests, the receipts from all sources would very nearly, if not quite, have balanced the cost of administering and protecting the Forests.

Such a commercial policy was not pursued because it would have meant sacrifice of an opportunity to promote the public welfare in the best way. It is of course just that the stockmen who profit by use of the National Forests should make a reasonable return for the privilege which they receive; but it is of first importance to prevent monopoly of the range by a few men, and make it do its share toward building up stable communities of independent American citizens. Hence the charge is fixed at what the man newly starting in business and without much capital can reasonably pay; and room is made for such men on the National Forest range, if necessary, by reducing the number of stock large owners are allowed to graze.

Thus the forage yield of the Forests, which sufficed for nearly 7,700,000 sheep, 1,500,000 cattle, 90,000 horses, and 150,000 hogs and goats, was utilized by more than 27,000 individuals and concerns, besides furnishing free grazing for milk cows and work horses of settlers, prospectors, travelers, etc. For every permit allowing the grazing of 4,000 or more sheep and goats there were 7.4 permits for 1,000 head or less, and for every permit allowing 200 or more cattle, horses, or hogs there were 9.4 permits for 40 head or less. The average number of sheep and goats to each permit was 1,541 and of cattle and horses 71. Thus what stands to the credit side of the grazing account is the wide usefulness of the range and the healthy upbuilding of communities, rather than the $1,000,000 of receipts.

THE TIMBER YIELD OF THE FORESTS.

The use of National Forests as sources of timber supply is less developed than their use either for water or for forage. The reason for this is obvious. The grazing industry in the West has expanded until it has reached almost everywhere the full capacity of the range in its present condition. The profitableness of irrigation and the steady demand of home makers for new land have led to water appropriations on a large scale, while power development, though in its infancy, is already seeking strategic positions and preparing for widespread application. But the timber of the National Forests is, comparatively speaking, in little demand. Its day has not yet come.

The additions made to the Forests last year brought the total estimate of timber to about 400 billion feet, exclusive of Alaska. The cut of the year was not quite 460 million feet, or a little over one-ninth of 1 per cent of the stand. In other words, it would take nearly 900 years, at this rate of cutting, to remove the present stand. Since the forests grow, after such cutting as takes place under Forest Service methods, at the rate of about 1 per cent of the original stand annually, only about one-ninth of the potential forest crop was harvested.

EFFECT OF GENERAL CONDITIONS ON NATIONAL FOREST BUSINESS.

The receipts from the National Forests in the fiscal year 1907 were about $1,530,000, an increase over those of the previous year of over 100 per cent. In the fiscal year 1908 they were about $1,790,000 and in that of 1909 about $1,765,000. It is now clear that during the present year they will reach a higher figure than ever before. In other words, instead of falling off violently in response to the period of business depression they remained nearly stationary during the two bad years and are now resuming their advance.

Had it not been for the large number of small sales a very great falling off in the cut of National Forest timber would probably have marked the year. Operations under large sales usually extend over from three to five years, so that the cut of each year includes much timber that was disposed of under sales of previous years, and the amount cut in a given year may be either much more or much less than the amount sold. In the fiscal year 1907 over 1 billion feet of timber was sold, but less than one-fifth of this amount was cut under sales. In 1908, 386 million feet were sold and something under 393 million feet were cut. But in 1909 the sales fell below 287 million feet, though the cut was 353 million feet. This was a decrease of 26 per cent from the sales of the previous year. Yet the number of sales for less than $500 worth of stumpage was within 1.2 per cent of the number for 1908. In other words, the small sales remained nearly constant, while the larger sales fell off heavily—as would be expected in a year of dull business. In short, had it not been for the steady demand of small purchasers and for the cutting under sales made before the trade reaction set in the National Forest timber business would have been quite as stagnant in the fiscal year 1909 as that of the lumber business generally.

WORK OF THE YEAR.

A notable change in organization was put into effect on December 1, 1908. Previous to that time all the work on the Forests had been directed immediately from Washington. Now six district offices, located at Missoula, Mont.; Denver, Colo.; Albuquerque, N. Mex.; Ogden, Utah; San Francisco, Cal.; and Portland, Oreg., have charge of the execution of all National Forest business. Only the larger questions of administrative policy are now handled in Washington. In consequence, business is transacted with far greater dispatch; close touch between office and field is easily maintained, and efficiency along all lines of work has been vastly stimulated. It is already clear that this was the most important forward step ever taken by the Forest Service—taking the Department to the people.

The cost per acre of National Forest administration was virtually the same as last year. Appropriations 14 per cent greater were applied to a gross area 11 per cent greater at the beginning of the year, and 18 per cent greater at its close, than at the same times the year before. On the basis of the gross area under administration at the end of the year, the expenditure for all purposes, including improvements, was 18.3 mills per acre; or, on the basis of the area exclusive of alienations, less than 20 mills. Since to protect the National Forests it is usually necessary to protect also alienated land within the Forests, the first figure more fairly represents the facts. In either the expenditure was less than 2 cents per acre. This contrasts with expenditures of from $1 to $2 or more per acre, which are annually made upon the highly lucrative forests of France, Germany, and Switzerland.

One-sixth of this expenditure went to making and maintaining improvements—chiefly trails, roads, telephone lines, and quarters for Forest officers. These improvements benefit both the Forests and the public. They make protection of the Forests far more effective and economical, provide better facilities for the transaction of business with Forest users, and serve the convenience of the public generally. The amount available for this work has only partly met the most urgent demands. If the Forests are to be adequately cared for and their usefulness is to be developed, they must be far better equipped with means of communication and transportation than they now are. The money thus spent is in reality an investment by the Government for the betterment of its own property and for the general welfare.

Deducting the cost of improvement work, there is left something over 1½ cents per acre as the cost of administration and protection. This includes a fair proportion of the general expenses of the Forest Service at Washington, as well as all expenditures made directly on behalf of the Forests. Since all forms of use by the public involve cost to the Government for supervision, and since use is increasing yearly, the amount available for fire protection is dangerously small and certain to be smaller unless the appropriations for the Service keep pace with the growth in use.

The desire of associations of timber-land owners in the West to give organized protection to the holdings of their members opened the way to an arrangement for joint action against fires by the Forest Service and certain of these associations where the private timber involved was within or near National Forest boundaries. An embarrassing difficulty arose from the fact that these private owners wished to spend more money per acre for fire protection on their own land than the Government had available for the Forests. This compelled the lumbermen to choose between paying part of the cost of protecting the public holdings and giving their own holdings less protection than business prudence called for. The situation illustrates how small, in proportion to the work to be done, is even the most liberal provision made in the past for the needs of the Forest Service. Agreements for cooperative fire protection were, however, concluded with the Potlatch, Coeur d'Alene, Pend Oreille, and Clearwater Timber Protective Associations, in the State of Idaho.

The forest-fire season of the summer and fall of 1908, disastrous throughout the country, brought relatively insignificant losses upon the National Forests. Statistics of fire losses are kept by the Forest Service not for fiscal but for calendar years. During 1908 fires on National Forests destroyed about $450,000 worth of timber. Of 2,728 fires reported, 2,027 were confined to an area of 5 acres or less.

At the request of the General Land Office claims on National Forests are examined by the Forest Service before patent is issued, in order that the Land Office may be cognizant of any facts bearing on the validity of the claim, which such field examinations may disclose. During the year 5,610 claims were examined and facts favorable to the claimant were reported in 3,003 cases and unfavorable in 2,112. Patents were issued by the Interior Department for 1,583 claims within National Forests, of which 633 were homestead entries, 514 timber and stone entries, and 425 mineral entries. While it is not desired to obstruct needlessly the perfecting of valid claims by bona fide entrymen, the interest of the people in their own property lays upon the Government the duty of protecting the Forests against unlawful attempts to patent the land.

There were listed under the Forest homestead law of June 11, 1906, 1,450 tracts of National Forest land, with a total acreage of about 140,000 acres.

An impression that the National Forests contain large areas of agricultural land to the exclusion of settlement and large areas of untimbered grazing land unjustifiably brought within the National Forest boundaries for the sake of grazing has gained wide currency. To satisfy myself on the ground as to the facts, I made personal investigation of these matters during the past summer in the States of Idaho and Wyoming.

Presumably the time will come when some portions of the present Forests can with benefit to the community be converted into farms. Through dry farming, plant breeding, and the introduction of new forms of useful and drought-enduring vegetation, agriculture is steadily gaining upon the desert, and may be expected to gain on the forest in semiarid regions. Growth in population also will bring an increasing demand for farm land. But it will also bring an increasing demand for timber and water conservation. The present is not the time to decide where the line should finally be drawn.

I found no evidence that the National Forests are withholding from settlement land now demanded for agriculture. As to grazing land, it is sufficient to say that proper administrative control of National-Forest grazing has necessitated the fixing of the boundaries where they now are, that public sentiment in the States visited is strongly in favor of the maintenance of the existing boundaries, and that representations that great areas of land are held for other than Forest purposes are in my judgment wide of the facts.

The total cut of National Forest timber during the year was nearly 460 million board feet, of which over 100 million feet were given away under free-use permits. The receipts from timber sales for the year were about $700,000. Free use of timber was heaviest in Idaho, with over 18 million board feet, followed by Montana, Colorado, Utah, and New Mexico, with amounts ranging from nearly 17 million to less than 10 million feet. California, Wyoming, and Oregon had each a free-use cut of between 6 million and 7 million feet. The remaining National Forest States follow with lesser amounts.

Of the timber cut under sales, Montana furnished nearly 86 million feet, or 24 per cent; Colorado 44 million feet, or 13 per cent; California 39 million feet, or 11 per cent; and Idaho 35 million feet, or 10 per cent. These amounts correspond to the following percentages of the estimated stand of National Forest timber in each State: For Montana, three-tenths of 1 per cent; for Colorado, four-tenths of 1 per cent; for California, four one-hundredths of 1 per cent; for Idaho, one-tenth of 1 per cent. In other words, the cutting is far within the growth capacity of the forests.

Reforesting of denuded land in the National Forests was pressed as vigorously as possible. Because of the expense and the great difficulties involved progress in the initial stages is slow. The watersheds which are receiving first attention are those most in need of immediate improvement for the benefit of municipal supplies or communities dependent on irrigation. About 450 acres were planted with young trees and 1,250 acres were sown with tree seed. The nurseries contained, at the end of the calendar year 1909, 7 million seedlings and transplants.

The National Forest range supported nearly 1 million more head of stock than last year—an increase greater than that made in the area under grazing control; in other words, the carrying capacity of the range under regulated grazing has advanced.

Under the cooperative agreement entered into with the Department of the Interior for the management of forests in Indian reservations, work was carried on in Washington, Oregon, California, Idaho, Montana, South Dakota, Arizona, Minnesota, Wisconsin, and North Carolina. This agreement provided that the Forest Service should take charge of all timber sales, supervise all logging, and protect against fire all forests on Indian reservations. It also provided that the Forest Service should prepare and apply plans for handling, as productive forests, all the timbered lands for which this was found to be the best permanent use. The ends sought were (1) to secure for the Indians the full value of all timber sold and (2) to safeguard and improve the forests themselves. All expenses incident to the conduct of the work were to be borne by the Indian Office, which also prescribed the policies to be followed in the employment of Indian labor, and in all other matters affecting the welfare of the Indians. Responsibility for all work in the woods was assumed by the Forest Service.

During the year 190 million feet of timber, worth over $1,000,000, was logged under the supervision of the Forest Service. Plans were prepared for the utilization by sale of much additional fire-killed and wind-thrown timber. Regulations were put into effect to prevent unnecessary waste and harm to the forests when Indians cut timber for their own use. The methods of logging on various operations in progress when the agreement was made were radically modified, to the great advantage of the Indians. Fire protection was effectively maintained in the face of unusually threatening conditions and with the saving of an immense amount of timber from destruction. The extension of the work contemplated by the agreement to all Indian reservation timber was prevented by the inability of the Indian Office to make the necessary allotment of funds.

Shortly after the close of the fiscal year this cooperative agreement was terminated.

Cooperation in the study of state forest problems of various kinds was conducted with New Hampshire, Kentucky, Alabama, Florida, Michigan, Oklahoma, Utah, and the Illinois state laboratory of natural history.

Forest studies in cooperation with private owners were made in 26 States, and by the Service independently in 16 States, in addition to the studies conducted on National Forests. Cooperative experiments in nursery and planting work were also made, chiefly in cooperation with state experiment stations and state foresters.

BUREAU OF CHEMISTRY.

In addition to its work in connection with food and drug inspection, the Bureau of Chemistry is engaged in numerous studies of a chemical nature, all in some way associated with the advancement of agricultural interests. Some of these have progressed so far that tangible results could be announced during the year.

Experiments with wheat show that soil and climate have a very important influence—perhaps a predominant influence—upon the chemical composition. For instance, seed of the Crimean variety of wheat grown in Kansas contained 20 per cent of protein, but when this seed was sown in California it yielded a crop with only 11 per cent of protein. The results of these experiments indicate that when crops are to be improved by selection it is essential that the selecting process be carried on in the locality in which the crops are to be grown.

With the view of securing information which may lead to the improvement of American wines, 110 samples of such wines were tested and analyzed, the various steps in the process of wine making as commercially practiced were observed at Sandusky, Ohio, representative samples of the juices of all the important varieties of grapes grown in that region were analyzed, and wine made by the Bureau from the leading varieties, under the most carefully controlled conditions, is now under observation. It is expected that these studies will make an important contribution to our knowledge of correct processes of wine making under American conditions.

The Bureau of Chemistry collaborated with the inspection laboratories of several cities in an effort to improve the quality of the milk furnished to the city consumers. It was found that adulteration of fresh milk was much more prevalent than had been thought. In one city the instances of watering, under the guise of ice placed in the can to cool the milk, were surprisingly numerous. Several convictions resulted, and it is believed that the local authorities have been materially assisted in their work.

It can now be stated that the quality of the drugs imported into this country has materially improved. When the work on drugs was begun it was rare that imported belladonna roots and leaves, for instance, were not found to be adulterated with some cheaper substances; but at present it is just as rare to find these drugs adulterated. There is still some importation of drugs which fall below the recognized standard, however. In interstate commerce, also, a certain proportion of adulterated drugs is still to be looked for. One sample supposed to be kamala examined during the year was found to be nothing but red sand, while powdered conium and ipecac have been found adulterated with powdered olive stones.

At the request of the Post-Office Department the Bureau of Chemistry analyzed 15 medicinal agents represented as cures for various maladies and sent or prescribed through the mails in violation of the postal laws.

Since the passage of the Food and Drugs Act the "prescription scheme" has arisen. Under this plan of selling proprietary medicines, a prescription is sent through the mails. The prescription will contain several well-known medicinal agents, but also a coined name of some unknown product. In order to fill the prescription, the recipient must purchase the agent sold under the coined name. Analyses of these products have shown that they usually consist of the cheapest and commonest of ingredients, although the advertisements would lead one to believe that the product with the coined name is new or rare, and that the remedies are panaceas for various diseases. Such remedies are plainly fraudulent, since they have no curative properties for the diseases for which they are recommended.

An investigation of the effects of acetanilid, antipyrin, and phenacetin, drugs commonly used in headache remedies of the present day, showed that the indiscriminate use of these drugs—or remedies containing them—without the advice of a physician, frequently produces poisoning, a drug habit, or, in some cases, death.

Tests of papers to the number of 1,559 were made during the year for the Government Printing Office, and 2,528 examinations of papers and leathers were made for the Post-Office Department. Besides these, 2,606 analyses were made of samples of supplies purchased on contract for the various Departments of the Government, and 5,511 pieces of apparatus were examined.

The study of paper-making materials has not yet revealed anything which can compete, under usual conditions, with rags, wood, straw, and the commonly used fibers in quality or in cost of papers made.

A study of the spirits of turpentine found on the market showed that about 20 per cent of the samples collected were adulterated, and the average amount of adulterants present was 6.5 per cent.

In experiments on the refining of wood turpentine by steam and by destructive distillation it was found that a wood turpentine of superior quality can be thus produced, although it has not been possible to secure a sharp separation of oils having a given boiling point. These studies are being continued.

In the fall of 1908 an experimental school was organized for instruction in the art of making denatured alcohol. The school was well attended. A series of lectures was given, covering all phases of the subject and extending over a period of nearly two months. Practical demonstrations of distilling processes were given in connection with the operation of a small but well-appointed distillery set up on the premises of the Bureau of Chemistry, the chief purpose of which was experimentation in the making of denatured alcohol from waste materials of the farm. The materials tested included molasses, apples, small grain, corn, watermelons, and potatoes. Definite conclusions have not yet been reached. It seems clear, however, that the profitable utilization of waste materials of the farm will call for especial skill, and that the manufacture of denatured alcohol in a small way in this country will require the instruction of a large number of young men in the art of fermentation and distillation.

The study of deterioration of foods in storage has been continued and has been extended to include storage at ordinary temperatures as well as cold storage. The analytical methods have been perfected, and the work has been carried on with careful attention to a greater variety of detail than during earlier years.

In the study of cold-stored chickens the Department is finding cordial cooperation among all classes who are interested in the handling of poultry. In the further investigation of this subject it is planned to make a complete study of all the conditions to which a chicken may be subjected from the time it is killed until it reaches the consumer. Such a study should result in valuable additions to our knowledge of the decomposition of flesh as influenced by commercial methods, and should also prove valuable to consumers since it must result in improved food supplies.

BUREAU OF SOILS.

THE SOIL SURVEY.

During the year the soil survey was concerned in the mapping of the soils of forty-five different areas in twenty different States. As the result of detailed surveys there was completed the mapping of 24,436 square miles of area, the maps to be published on a scale of 1 inch to the mile, upon which scale an area of 10 acres has been considered the unit. In addition to this, reconnoissance surveys of large areas were completed in the Great Plains country. Westward of the ninety-ninth meridian to the foothills of the Rocky Mountains, where the soils generally are level or gently rolling, they are uniform over rather large areas, and the climatic conditions are such that, except under conditions favorable for irrigation, general and "extensive" farming must prevail for a time. It is estimated that this area contains approximately 500,000 square miles. In this region, extending from Canada on the north to Mexico on the south, I have directed that the soil survey be so made that the maps may be published on a scale of 6 miles to the inch, which is adequate to cover the needs of that country for many years to come. On this scale all of western North Dakota was surveyed and the report and map were prepared for publication. An area of 16,000 square miles in southwestern Texas was also completed, and the report and map on this area are about ready for publication. An area of about 10,000 square miles has been completed in the Panhandle of Texas, but as it is anticipated that the whole Panhandle region can be completed during the coming fall and spring the report upon this area is temporarily withheld, awaiting the completion of the survey of the entire region. The survey of the western half of South Dakota has been completed and the force will be moved into southern Texas. A total area of 76,180 square miles was surveyed in the Great Plains region, and it is expected that by the end of the present fiscal year western Nebraska, western Kansas, and the whole of the Panhandle of Texas will be completed, making almost a continuous strip from Canada to Mexico. This will leave the western half of the area to be completed, including eastern Montana, eastern Wyoming, eastern Colorado, eastern New Mexico, and western Texas.

Reconnoissance survey work is also being carried on in the Appalachian region, and by the end of the present field season practically all of western Pennsylvania will be mapped on a scale of 6 miles to the inch. This same scale of work is also being used in the cut-over pine lands of Washington, giving excellent results for large areas of fairly uniform soils in a region relatively thinly settled, and at a very much lower cost per square mile than for the more detailed work required in the Eastern States, in the irrigated areas, or on the California coast. Altogether the soil survey has mapped during the fiscal year an area of 100,616 square miles, at a total cost of about $145,000, including the field and office expenses. This makes in all for the soil survey 257,694 square miles which have been surveyed and mapped since the beginning of the work in 1899.

SOIL FERTILITY.

A great and fundamental problem which has confronted our people, as it has the people of the world, is the question of the permanency of soil fertility. Of late years, particularly, the idea has prevailed that the soils of various parts of the United States are wearing out through loss of mineral plant food, and that a serious condition is thus presented for the future of our people. So important and fundamental is this problem for the welfare of our people that I directed a thorough examination to be made of the whole subject, and an exhaustive report has been issued, from which certain important conclusions can be given in a few words.

It has been found from the records kept by our own Department that, on the average, crop yields per acre have shown a decided tendency to increase during a period of forty years, and that there is no evidence of general decrease over large areas or in any particular State, as is popularly supposed. This indicates, undoubtedly, that on the average our people are farming more intelligently and therefore more successfully, and that we are, through these more intelligent methods, winning gradually larger returns from the soil.

It has been held, however, by some writers that even if the yields are increasing, the element of danger is that the larger crops remove larger amounts of plant food from the soils and bring nearer the time when the soils will eventually wear out. To meet this argument it has been necessary to extend the investigations into older countries, and the records of Europe have been searched for information in regard to the past history of these older countries that can be taken as a safe guide for the future of the newer soils of the United States. These records indicate that in the middle of the sixteenth century, or, roughly speaking, three to four hundred years ago, the soils of central and northern Europe were producing on the average about as much wheat as the soils of the United States are producing at the present time. These European soils have been occupied for agricultural purposes for at least a thousand years, during most of which period the country was more densely populated than the United States is at the present time. So far as records are obtainable, they indicate that as a result of increasing population and more intensive and more intelligent methods of soil control, and in spite of their longer occupation, the average yield per acre has increased, until in the case of northern Europe the soils are now producing about two or two and one-half times as much per acre as the newer soils of the United States are producing.

In addition to this evidence of actual crop yields per acre, an exhaustive investigation has been made of all the chemical analyses which have been made of soils for the last eighteen years in certain countries of northern Europe in which crop yields have been increasing, and likewise of the soils of the United States, including the older soils of the Eastern States and the newer soils of the Western States. The results of these analyses, published side by side, show no significant difference in chemical composition between the older soils of Europe and the newer soils of the United States. Microscopical examinations of the soils fail to show that the longer occupation of the soils of Europe has changed noticeably the mineralogical character of the soils. It is reasonable to infer from the work that has been done that within historic times the occupation of the soils for agricultural purposes has failed to noticeably change the mineral character of the soil material upon which the future life of the nation must ultimately depend. The reasons for this and the laws of nature which permit the soil thus to be continuously occupied and used for mankind as freely as the air are complicated and difficult to understand, and offer a profitable field of research for our agricultural colleges and experiment stations.

The first lesson that our people must learn—one which is taught by the operations of the soil survey—is that we have a great variety of soil types (700 different types of soil having already been encountered in the area that has been surveyed), and each one of these soil types has its own peculiarities, its own characteristics, and its own peculiar adaptation to crops, rotation schemes, and methods of soil control. This is the great fundamental fact which our farmers must understand: The first step in agricultural development is the knowledge of the particular soil characteristic of the farm.

ABANDONED FARMS.

The United States has been developing for agricultural purposes an area as large as the whole of Europe, while its population is but little larger than that of any one of several European countries. So much has fashion and sentiment had to do with this agricultural development that many of the lands, particularly in the Eastern States, have been practically abandoned, so far as profitable agricultural use is concerned, by the shifting and moving of our agricultural population into new regions in which lands are purported to be cheaper and in which the advertised inducements have been proportionately large. With the rapid extension, also, of our industrial life and the opportunities offered in the past in business and in the professions, the cities have called upon the country for clear brains and vigorous bodies to such an extent that large areas have become so depopulated of active and vigorous minds and bodies that the stock is insufficient to repeople the country districts. The result has been that some of the most fertile lands in our Eastern States, some of the most fertile lands of the world, have been left in a condition of practical if not actual abandonment, and the price of provisions has increased for the simple reason that there are not enough people to actually work the soils and to raise the crops necessary to feed the nonproducing population of the cities.

BUREAU OF ENTOMOLOGY.

Several important practical results have been reached by the Bureau of Entomology in the course of the year, and excellent progress has been made in all of its investigations. Certain new lines of work have also been begun.

GIPSY MOTH.

The gipsy moth has been held within the bounds established a year ago except in the State of New Hampshire. Here a number of localities have been discovered to the north of the old infested region. It is not probable, however, that the spread of the insect to these localities has been recent, but rather that they are simply points at which it has not previously been discovered. Cooperation with the state officials of Maine, New Hampshire, Massachusetts, Rhode Island, and Connecticut has been continued. The force of the Bureau has continued cutting underbrush and removing deadwood and undesirable trees to a distance of 100 feet from the roadway on either side of the roads leading through the worst infested woodlands. More than 300 miles of roadway have been cleared in this manner, making it impossible for gipsy moth caterpillars to drop from trees along the roads upon passing vehicles. These strips have also been sprayed with arsenicals, and the trees have been banded with sticky paper, so as to prevent the ascending of caterpillars crawling from underbrush. The improvement in the infested territory in Massachusetts, Maine, Connecticut, and Rhode Island has been marked except in woodlands proper, and much experimental work has been carried on which indicates that eventually it may be possible to apply remedial measures in such localities.

An important step in preventing the further spread of the gipsy moth has been taken in cooperation with the different railroad corporations operating within the infested territory. Under a regulation put into effect by the railroads on July 1, 1909, shippers of lumber, cordwood, fence posts, railroad ties, and other forest products are required to present a certificate of inspection before the railroads accept the shipments. Shippers now request inspection from the Department's agents. It is thought that by this method the danger of spread in this way will be minimized, and this method of spread is considered as secondary only to the carriage of caterpillars dropping from roadside trees on passing vehicles.

IMPORTATIONS AND EXPORTATIONS OF USEFUL INSECTS.

In cooperation with the State of Massachusetts the extensive experiment in the introduction of foreign parasites of the gipsy moth and the brown-tail moth has been carried on as in previous years. An American agent was sent to Russia, the Chief of the Bureau of Entomology visited different European countries, and the different European governments as well as the government of Japan have cooperated through their official experts, while several private entomologists have also cooperated in a hearty manner. The result has been that more parasite material was received during the year than ever before. The best results have come from France and from Japan.

During the year twelve species of introduced parasites and predatory insects have been recovered from the field, indicating a reasonably certain establishment in this country. The close of the year finds twice as many species of introduced parasites in the field as were present last year. Many of them have scattered over extensive areas, one species having been found over an area of 500 square miles. It is hoped, by the continuance of the same and improved methods, that this number will be increased during the present year.

News has been received from Italy that American parasites of the mulberry scale insect sent to that country in return for similar favors to this Government have established themselves in certain regions in such numbers that the danger from the scale is considered passed. Certain ladybird beetles have been sent by the Department to Malaga, Spain, for the purpose of preying upon a species of mealy bug. Parasites of scale insects have been sent to Peru. A species of tick parasite occurring upon the dog tick in Texas has been sent to South Africa. The exportation of bumblebees to the Philippine Islands for the purpose of fertilizing clover is reported to have been measurably successful, and American bumblebees have been found in certain regions in the Philippines during the year.

MEXICAN COTTON BOLL WEEVIL.

The work conducted by the Department against the Mexican cotton boll weevil has been followed up in much the same way as in previous years. The crop of 1908 was damaged to the extent of about $30,000,000, the loss in Texas being light compared with that in Louisiana and a small portion of the State of Mississippi that has been invaded. The lesser loss in Texas, however, was due to abnormal weather conditions. The great loss in Louisiana is a verification of the prediction made for several years, and it indicates the importance of means of control adapted to such conditions as are found in Louisiana and other States that will soon be invaded by the weevil. The insect enemies of the boll weevil have come to be of great importance, and examinations made to determine the mortality rate due to this cause have indicated that in one case 77 per cent of the boll weevils in a field in Louisiana were being destroyed by their insect enemies, and at various points in Texas 21 to 48 per cent were killed in the same way. It is evident that the extent of control secured in this way is greater than that by any artificial means. It has been found feasible to make certain changes in the planting and cultivating systems that will greatly facilitate the work of the natural enemies of the weevil. Experiments in the introduction of parasites from one region to another have been measurably successful.

INSECTS DAMAGING DECIDUOUS FRUITS.

PEAR THRIPS.

The results from the work on the pear thrips in California during the fiscal year were admirable, and the investigation has been eminently successful. Full studies of the life history of the insect were made, extensive experiments in all directions were carried on, and, with a basis of accurate life history knowledge, the substantial control of the insect has been accomplished. Early experiments in deep plowing of the soil during the summer to destroy the larvæ of the thrips, which at this period are all beneath the surface of the ground, gave practically negative results, since the larvæ are active at this period and are quickly able to construct new cells in which they live undisturbed. In the fall, however, it was discovered that deep plowing and cross plowing, with harrowing after the first rains, was very effective. At this time the insects are mainly in the helpless pupal stage, and are very susceptible to any disturbance. In two orchards in the Santa Clara Valley where this method was thoroughly tried there were killed, respectively, 70 and 73 per cent of the insects. This process also puts the soil in better condition to retain the water from the winter rains and brings about a more vigorous condition of the trees. More than 70 per cent of the insects being destroyed by this process, it has been found that from 90 to 97 per cent of the remainder may be killed by proper spraying, under high pressure, in a downward direction, with a combination spray of a diluted tobacco extract and distillate oil emulsion. Demonstration work resulted in the protection of the blossoms and the production of a full crop in orchards in which for some years practically the whole crop had been destroyed. The problem, therefore, is solved, and with a few additional demonstrations the handling of the pear thrips can safely be left to the orchardists.

CRANBERRY INSECTS.

The work on cranberry insects has been continued and enlarged. Owing to conditions which render flooding of bogs of questionable safety, especially in midsummer, in Wisconsin, attention has been largely devoted to sprays. Demonstration experiments in spraying have been carried on in different portions of the cranberry marshes in the Cranmoor district of Wisconsin, and have shown uniformly good results. Combination sprays of Bordeaux mixture and arsenate of lead have reduced injury by the fruit worm from 60 per cent down to 14 per cent, which means an equivalent in money gain of about $86 per acre.

FIELD CROP INSECTS.

The work on field crop insects has been largely devoted to the green bug, the joint worms, and the Hessian fly.

THE SO-CALLED "GREEN BUG."

This insect was practically absent from most of its range until the early fall of 1908, on account of its great reduction in numbers by natural enemies, but studies were continued in which it was found that this insect has twenty-five native food plants and a number of parasites hitherto unknown. Moreover, a knowledge has been gained of just when and under what conditions the parasites of the "green bug" can be depended upon to prevent an invasion, and what the farmer must do himself to reduce the severity of the invasion. Some local outbreaks occurred in the spring of 1909, and investigations have shown that the farmer can do much to protect himself by preventing the growth of volunteer grain in fields intended for fall wheat or oats, and by delaying the sowing of these crops as late in the fall as possible, the object being to prevent the pest from becoming established in the fields until as late a date in the fall as possible.

JOINT WORMS.

Careful studies in the Northwest of the damage by the wheat straw worm indicate that its injuries can be prevented by cultural methods, namely, by rotation of crops, clean, early summer fallow, and the temporary abandoning of spring-wheat culture in the infested regions. Studies of the true joint worm in Ohio, Indiana, and Illinois, where a serious outbreak has occurred, indicate that late seeding of wheat, in connection with rotation of crops, tends to reduce its injuries.

HESSIAN FLY.

The wheat-sowing experiments started in Kansas in 1907 have resulted in the gaining of information whereby a threatened outbreak in 1909 was practically avoided, owing to a campaign of late sowing based on these results, instituted and followed up by the state experiment station, the agricultural press, and millers, grain dealers, and, in one instance, by a church organization. It is estimated that the wheat-sowing experiments in Kansas resulted this year in the saving of $500,000 or more.

INSECTS AFFECTING CITRUS FRUITS.

WHITE FLY.

The investigation of the white fly in Florida has been continued with the purpose in view of placing every practicable manner of control on the best possible basis. During the fiscal year life-history studies and fumigation experiments were practically concluded, and experiments with contact insecticides were taken up again, after having been discontinued temporarily to allow for the conclusion of the fumigation experiments. Experiments with fungous parasites of the white fly were continued with much progress, and the study of trap foods has been taken up. The discovery of another injurious species of white fly of citrus fruits in Florida has made necessary comparative studies of life history, economic importance, and control, although this second species is fortunately more easily controlled than the first. Fumigation experiments were conducted on a large scale in cooperation with several orange growers, and a number of practical points in fumigation have been brought out.

HYDROCYANIC-ACID GAS FUMIGATION IN CALIFORNIA.

This work has been continued along strictly economic lines, with the primary object of increasing the efficiency of fumigation as well as of reducing its cost. The results have already practically revolutionized the old wasteful procedure, which possessed none of the elements of uniformity. The entire practice of fumigation has been rapidly standardized. Before the next season closes it is prophesied that practically all fumigating outfits in southern California will be working under the standard system devised by the Bureau of Entomology, and it seems probable that, after the general adoption of the system, a single treatment every second year will accomplish the same results as an annual treatment, thus giving an annual saving of from 30 to 50 per cent of the present cost.

INSECTS WHICH CARRY DISEASE TO MAN AND DOMESTIC ANIMALS.

Work on mosquitoes has been carried on actively, as during the last ten years, and yet during the year new points of practical value have been brought out. It has been discovered that a large part of the mosquito supply of otherwise well-conditioned portions of large cities is sewer-bred, and that malaria-bearing mosquitoes in dry summers will breed in the sewer traps, making it extremely important for the health officials to treat all sewer traps with kerosene or some other "culicide." Work on the house fly has been continued, and a bulletin on this insect and other disease-bearing insects has been published, which has attracted still further attention to this unnecessarily dangerous pest. The crusade against the house fly, indicated in my last annual report, has become during the fiscal year of almost a national character. So many boards of health have taken it up, and so many civic organizations have turned their attention to this subject, that the whole country may be fairly said to have been aroused.

INSECTS INJURIOUS TO STORED PRODUCTS.

Several insects of this class have attracted much attention during the year, and investigations begun in 1908, at the request of many milling companies in Kansas, Oklahoma, Missouri, and Texas, and of steamship owners and operators in Texas and Louisiana, have been continued. Special attention has been given to the flour beetles and to the important question of determining the place or places at which export flour from the different States mentioned becomes infested, whether chiefly at the mills, or in Galveston, or at New Orleans, or on the cars, steamships, or on wagons used in carting material from the mills to the carrier. There is no doubt that infestation occurs at all of these points, but it is feared that in some cases primary infestation begins at the milling establishments, although some of the mills which have been investigated are kept scrupulously neat and are thoroughly fumigated at least twice yearly. More attention has been paid to the Mediterranean flour moth than to any other insect of this class. This seems to be the most serious mill pest in the world. Investigations by the Bureau of Entomology indicate that fumigation of milling establishments with hydrocyanic-acid gas is the most perfect remedy. Bisulphid of carbon is less effective, as a rule, and the same may be said of sulphur dioxid.

BUREAU OF BIOLOGICAL SURVEY.

The essential basis of the work of the Biological Survey is the study of American birds and mammals in their economic relations. Many of our mammals and a few of our birds are seriously destructive, so that accurate knowledge of the food and habits of such pests and of effective means for reducing their numbers and preventing their ravages is becoming more and more necessary to profitable agriculture and stock-raising. Almost as important is a widespread knowledge of the part our useful birds and mammals play in aiding the farmer; for it is an undoubted fact that, taking the country as a whole, the number of our game and insectivorous birds and of our useful mammals may be augmented with great advantage to the farmer.

The constantly increasing number of sportsmen and the growing demand for game for food partly explain the relative scarcity of game birds and mammals, while the destruction of forests, the encroachment of civilization on the homes of wild birds, and their destruction by predaceous mammals, especially cats, and for ornamental purposes, go far to explain the diminished number of many kinds of useful birds. The public must have a thorough understanding of the important part birds and certain animals play in checking the increase and spread of noxious insects before present conditions can be improved. Much may be done through the education of the young, especially the pupils in our public schools. By the distribution of publications containing the essential facts in regard to the habits and food of birds, the Biological Survey seeks to aid materially in this educational work. It is gratifying to be able to state that the demand for this kind of literature on the part of educators is constantly increasing. Nor are evidences wanting that a fuller comprehension of the services rendered to agriculture by birds and mammals and of the means necessary to protect and encourage them is already bearing fruit.

HOUSE RATS.

Although from very remote times rats have been recognized as pests, it is only recently that their extermination has assumed international importance. Investigations in many parts of the world reveal the fact that everywhere the losses occasioned by these mischievous rodents are enormous. House rats appear to be constantly increasing, and the discovery that they convey the germs of disease, especially plague, from place to place and from port to port, renders their destruction highly important.

While in several countries, notably England, Denmark, and parts of the United States, vigorous efforts have been made to exterminate rats, or to materially lessen their numbers, the results thus far attained are not reassuring. The rat is exceedingly wary and difficult to destroy, and is very prolific. Except where funds are practically unlimited, and cooperation possible on an extensive scale, the check to increase is only temporary, and in a few months after efforts have relaxed the rodents are as numerous as ever. The true remedy for the rat pest therefore lies in prevention rather than cure. The rat pest has its origin chiefly in cities, especially seaports, spreading thence to smaller towns and to the country. Hence it may be most effectively dealt with through municipal ordinances. As a measure of first importance the rat-proofing of all buildings within city limits should be rigidly enforced. Such ordinances when supplemented by the withholding of food from the rodents would go very far indeed toward finally abating the evil.

The present most important source of food supply for rats is garbage of various sorts, especially kitchen refuse. Immense numbers of these rodents are fed in the back yards and alleys of cities. The storage of household garbage in closed containers, which should be frequently and systematically emptied, is, therefore, an absolutely necessary supplementary measure, as also the protection of all sorts of forage, much of which is now loosely stored and easily accessible to rats.

Requests are constantly received from all parts of the country for information as to the effectiveness of bacterial preparations for destroying rats. A number of these preparations have been put on the American market and widely advertised, and during the year tests have been made with several of them. When fresh and virulent, such preparations may usually be relied on to kill most of the rats which eat infected baits. The experiments fail to show, however, that the disease set up is in any sense contagious. On the contrary, it is confined to the individuals eating the baits. To some extent bacterial diseases may be communicated from dead rats to live ones, when rats that die from the disease are eaten by their comrades. Infection in this way, however, occurs on too small a scale to add materially to the effectiveness of the preparations. Thus more or less uncertain of action, limited in effectiveness, and costing so much as to make their use on a large scale practically prohibitive, none of the bacterial preparations thus far tested can be recommended to the public.

CALIFORNIA GROUND SQUIRREL.

Among our more destructive rodents are the ground squirrels, which annually take a toll of $10,000,000 from the farmer. But the economic aspect of the case is quite overshadowed by the recent discovery by the Marine-Hospital Service that, like rats, ground squirrels in California serve as active agents in the distribution of plague. In one county 175 squirrels were found on examination to contain the germs of this dreaded disease, and they form probably only a small percentage of the whole number infected within the limits of a single county. Several cases of plague in man have developed as the result of bites from fleas harbored on squirrels. Thus the war against ground squirrels ceases to be merely of local interest and becomes of national moment. The extermination or reduction to comparatively insignificant numbers of the California ground squirrel, important before, is absolutely necessary if plague is to be stamped out in the United States, and only the most vigorous and persistent measures can be successful.

During the past year the Biological Survey has done much experimental work, on which it is still engaged, for the purpose of ascertaining cheap and effective methods of destroying these animals on a large scale. A formula for poisoning squirrels with barley and strychnine has been found which seems to meet the requirements better than any yet tried. The aim should be the complete extermination of ground squirrels over certain areas, especially those contiguous to seaports and other towns where the squirrels are likely to come in contact with plague-infested rats. The extermination of the animals over the whole of their present range in California, especially in the mountains, is quite impracticable under present conditions because of the great expense.

The Biological Survey aims to aid in the suppression of the rodent plague in every way possible, and, so far as funds are available, will, when requested, send skilled assistants to infested localities to demonstrate the best methods of ridding land of squirrels and other rodents.

PRAIRIE DOGS.

Over large areas of the Plains regions and adjacent lower slopes of the mountains prairie dogs exist in great numbers, and wherever they occur in large colonies they are a pest, being very destructive to alfalfa, grain, and other crops. Even on lands devoted solely to pasturage they are a serious pest, since a few hundred of the little animals will consume as much grass as a cow. As their colonies often extend for miles and number hundreds of thousands, the quantity of grass devoured by their combined numbers is very great. An effective formula for poisoning prairie dogs was worked out some years ago by the Survey and is now being used by the Forest Service in ridding lands within and contiguous to the National Forests. Further investigations were begun last year, and are still being carried on, to discover a still more effective and cheaper formula for destroying the animals. It is easy at moderate cost to absolutely exterminate small isolated colonies, but when thousands of acres are to be freed from the pests the cost becomes an exceedingly important item.

LIME AND SULPHUR WASH AS A REMEDY FOR THE RABBIT PEST.

During the last year the lime and sulphur wash, which for a number of years has been employed to prevent damage to trees by the

San Jose scale, was tried with great success in several localities as a protection for orchard trees against the attacks of rabbits. The remedy is cheap, and as a rule a single treatment in the fall appears to protect trees for the entire winter. Its more extensive use is recommended.

FIELD MICE.

No infestation of an agricultural area by field mice at all comparable in magnitude to the invasion of certain alfalfa districts of Nevada in 1907–8 has occurred during the last year. These little rodents are, however, numerous and widespread over the United States, and the damage they do to garden, truck patch, orchard, and alfalfa field reaches annually a large aggregate in dollars and cents.

PROPAGATION OF BIG GAME.

The possibilities of growing venison for the market and of propagating deer, elk, and other large mammals within preserves has continued to receive the attention of the Survey. It is now well known that our native deer are well adapted to semidomestication, and their growing scarcity emphasizes the need of efforts to increase their numbers. The favorable reception by both farmers and sportsmen of a bulletin on Deer Farming attests the growing interest in this phase of game protection.

RELATION OF BIRDS TO FRUIT RAISING.

Birds frequent orchards chiefly for two reasons—to seek the insects that prey on fruit and fruit trees, and to feed on fruit. Fortunately the birds that are seriously destructive to fruit are few, while the greater number resort to orchards in the interests of the fruit grower. A careful study of California birds in relation to fruit raising has been in progress for several years, chiefly for the purpose of ascertaining the exact nature of the food of orchard birds and of informing orchardists how to discriminate between friends and foes, that they may encourage the one class and prevent or lessen losses from the other. The first part of a report on the subject was issued in 1907 and widely distributed throughout the State. The second and final part has been prepared and is now ready for the press. These investigations are being continued in Oregon and Washington, in both of which orcharding is an important and growing industry.

GAME PRESERVATION AND INTRODUCTION.

The preservation of our game and birds, though growing more difficult with increasing population, is making satisfactory progress. Each year brings a clearer understanding of the need for protection and for improvement in state laws. The hunting-license system, whereby a fund is provided for enforcing laws and restocking covers, has grown steadily in favor, and is now in operation in all but one or two States. Refuges where game may breed in security, to overflow into neighboring regions, are rapidly increasing in number, and the practice of caring for game in severe winter weather is spreading.

IMPORTATION OF BIRDS AND MAMMALS.

Although the importations of birds and mammals (exclusive of ruminants and swine) aggregate nearly half a million, inspection is so thorough that the danger of the introduction of pests is practically eliminated. Two or three minor violations of the law came to light during the year and were promptly dealt with. The main interest in these importations attaches to the number of game birds imported. Nearly 30,000 gray partridges (commonly known as Hungarian partridges) were brought from Europe for liberation in the United States, chiefly in California, Connecticut, Illinois, Indiana, and Kansas. This is an advance of more than 400 per cent over last year's importation of these birds, which was more than 100 per cent above that of 1907. This remarkable increase indicates the growing tendency to apply the proceeds from hunting licenses to restocking covers. Only 1,200 pheasants were imported for this purpose—about as many as were brought in for aviaries.

Experiments in stocking preserves by means of eggs imported from Europe were continued, chiefly by one preserve owner in North Carolina, and 5,050 eggs of pheasants, partridges, and wild ducks were imported.

INTERSTATE COMMERCE IN GAME.

Even with the hearty support lent by sportsmen to modern game-protective measures, one of the most difficult problems in game preservation is the suppression of illegal traffic in game. A few cases of violation of the Lacey Act were taken up. Out of 9 reported to the Department, 4 resulted in conviction, 2 were settled out of court, and the remaining 3 are still pending. An important case, involving the shipment of 512 quail from Oklahoma to Chicago, which has been pending since 1905, was concluded, and the defendant was fined $400.

It has been extremely difficult to deal with these violations in the past, but two events of the year have removed some of the obstacles. The federal law has been greatly strengthened by the passage of the criminal code, and Illinois and Missouri, in both of which States there is considerable trade in game, which centers largely at Kansas City, St. Louis, and Chicago, have greatly improved their statutes, thus strengthening the federal law, which rests on state legislation. Hereafter it will be easier to deal with violations of the law, though supervisors at a few central points, for which no provision is at present made, are essential to full enforcement of the law.

BIRD RESERVATIONS.

The setting aside of government lands, of little or no agricultural value, for bird reservations (sanctuaries where colonies of birds may breed safely or take refuge during migration) has proved an important means of increasing bird life, and during the year the number of such reservations was more than trebled, the increase being from 16 to 51. Some of the new reservations differ in character from those previously established. Two in Oregon, on Klamath and Malheur lakes, and one in Alaska, at the delta of the Yukon, comprise considerable areas of marsh land that form breeding grounds of wild fowl. Another, which embraces several of the western islands of the

Hawaiian group, covers 5° of latitude and 21° of longitude and contains one of the largest and most famous breeding colonies of sea birds in the world. Others consist of reservoir sites of reclamation projects; these artificial lakes in arid regions will doubtless attract many birds, which in future will be protected.

GAME REFUGES.

The 20,000-acre national bison range on the Flathead Indian Reservation in Montana will soon be ready for occupancy, and the American Bison Society has already raised $10,500 for the purpose of stocking it with buffalo.

The summer range of the Roosevelt elk, which comprises the higher summits of the Olympic Mountains in Washington, was set aside as a national monument by executive order, issued on recommendation of this Department.

PROTECTION OF GAME IN ALASKA.

Many persons availed themselves of the privilege accorded by the new Alaska game law of shipping trophies out of the Territory prior to September 1, 1908, and the shipments included nearly 175 heads and horns of moose, caribou, and mountain sheep. A few trophies have since come out under license, and the Department has issued permits for the export of 81 specimens, chiefly heads and horns of the above-named species for exhibition at the Alaska-Yukon-Pacific Exposition at Seattle.

COLLECTION AND PUBLICATION OF INFORMATION CONCERNING GAME.

Careful investigation has been made during the year of the present distribution of big game, especially deer and antelope, and the number killed during the hunting season. East of the Mississippi (omitting New Hampshire, Georgia, and North Carolina) 60,000 deer were killed last season. Antelope are still found in 14 Western States, though the total number is approximately only 17,000. Notwithstanding the fact that the antelope is protected throughout the year in practically all the States in which it now occurs, special efforts are necessary to save this fine game animal from extinction. In the decade from 1898 to 1908 the antelope of Colorado, according to estimates of the state game warden, decreased from 25,000 to 2,000.

DIVISION OF ACCOUNTS AND DISBURSEMENTS.

During the year there were received, audited, and paid 56,288 accounts, amounting to $9,359,808.97, exclusive of approximately 32,111 accounts of the Forest Service, which received an administrative examination and audit in the division. Of these accounts, moreover, 3,712 were so-called " combined " accounts, in connection with which there was probably a saving of at least 22,272 checks, to say nothing of the saving of other clerical labor in connection therewith. There were also audited and sent to the Treasury for payment 2,518 accounts. In the payment of the accounts settled directly by the Division of Accounts it was necessary to draw 107 requisitions on the Treasury and subtreasuries, and issue 108,886 checks. There were issued during the year 20,636 requisitions for supplies, 4,101 letters of authorization for travel, 24,687 requests for passenger travel, 1,201 requests on the Quartermaster-General for the transportation of government property, and 1,626 department bills of lading, while 75,750 letters were written or received in the ordinary transaction of business.

To carry on the work of the Department of Agriculture during the fiscal year ended June 30, 1909, Congress appropriated the sum of $16,063,106, an increase of $2,940,066 over the preceding year. Of this appropriation $11,355,106 covered the ordinary expenses of the Department, $3,000,000 the permanent annual expense for meat inspection, $1,248,000 the agricultural experiment stations, and $460,000 the printing and binding done under the Public Printer.

The disbursements of the Department for the fiscal year 1909 amounted to $14,610,295.64 and the greater part of the balance of $1,634,024.55 will be required for the settlement of outstanding liabilities. The apparent excess of disbursements over the appropriations for this fiscal year is due to unexpended balances, amounting to $181,214.19, brought forward from "Administration, etc., Forest Reserves," and other special appropriations.

The amount paid for rent of buildings in the District of Columbia for the several branches of the Department was $70,245.

All accounts for the fiscal year 1907 having been settled, the unexpended balance of appropriations for that year, amounting to $1,200,165.81, was covered into the Treasury on June 30, 1909. The account for the fiscal year 1908 is still open.

The amount estimated for the fiscal year 1911 in the annual estimates for the regular appropriation bill is $13,377,136, which includes $720,000 for agricultural experiment stations. In addition there will be a permanent appropriation of $3,000,000 for meat inspection, a permanent appropriation of $720,000 for additional allotments to agricultural experiment stations under the Adams Act, and $460,000 for printing and binding to be done under the Public Printer, making a grand total of $17,557,136.

In the estimates for 1911, $397,500 additional is requested for the protection and use of 26,528,439 acres which were added to the national forests during the fiscal year 1909, at too late a date, however, to enable Congress to provide therefor in the agricultural appropriation act for 1910; while in the Division of Publications the amount requested for labor-saving machinery and photographic equipment for 1911 is $2,400 less than the amount provided for 1910, and in the Bureau of Animal Industry $13,000 less is requested for use in connection with the Bureau experiment station during 1911 than was provided during 1910, making the net increase of the 1911 estimates over the 1910 appropriations $382,100, exclusive of the additional allotments to agricultural experiment stations under the Adams Act. Numerous minor changes have also been made in the estimates, none of them, however, affecting the total amount requested. In the appropriation act for 1910, several of the lump-sum appropriations were broken up into numerous more specific subappropriations, and in the 1911 estimates this plan of subdivision has been considerably extended, notably in connection with the work of the Forest Service. While it is readily seen that this division of lump-fund appropriations into more numerous subappropriations will enable Congress to appreciate more fully how the money for the Department is to be expended, and will, on the whole, make for economy of expenditure, it is equally apparent that the bookkeeping and other clerical work of the Division of Accounts in connection with the large numerical increase in the appropriations will be considerably heavier than heretofore.

DIVISION OF PUBLICATIONS.

During the year 1909 the publication work of the Department exceeded that of any preceding year. A larger number of different publications were issued, and a greater number of copies were printed and distributed. Such an increase was to be expected. Publication is the principal means by which practical effect is given to the studies, investigations, and experiments of the Department. The rapid growth of this Department and the extension of its activities must be accompanied by an ever-increasing volume of printed matter if the Department is to accomplish the purpose of its existence.

The total number of different publications ordered printed during the fiscal year 1909 was 1,200, containing a total of 42,263 printed pages, and the total number of copies was 17,190,345. Of these about 60 per cent represented new publications of the year. These figures do not include an aggregate of more than 10,000,000 copies of weather maps and other minor publications issued from the Weather Bureau stations outside of Washington. Neither do they account for the printing and distribution by Congress and by the Superintendent of Documents of several million copies of important publications contributed by this Department.

That the publication work of the Department is receiving the attention which it deserves is proven not only by the absence of criticism but by the great and growing demand for the Department's printed matter. In all lines of the work high standards have been set, and the work of the past year shows that the Division of Publications has met the requirements of these standards. The limitations of the printing fund have made necessary the most rigid economy in printing, illustrating, and binding in order to secure the largest possible output of the very best reading matter on all lines of agricultural research and experimentation.

SALE OF PUBLICATIONS.

In order to avoid wasteful distribution of printed matter, it has been necessary to limit more strictly the gratuitous distribution and to depend more largely on the sale of publications by the Superintendent of Documents at prices sufficient to cover the cost of printing. That official reports for the past year a greater sale of this Department's publications than ever before. The total number of copies sold during the year was 117,218, and the amount received for these was $16,293, an average of about 14 cents per copy. The sales of a single publication, that popularly known as "The Horse Book," netted more than $1,100. The sale of agricultural publications has trebled within three years. The most commendable feature of this system is the use of the money resulting from sales in reprinting publications to supply the demand. By this means a large number of valuable publications are made continually available. The Superintendent of Documents during the fiscal year reprinted 55 publications of this Department, issuing a total of 44,354 copies.

FARMERS' BULLETINS.

The first number in the Farmers' Bulletin series was issued in June, 1889, just twenty years ago. The latest issue of the year just closed was No. 361, and the number of copies issued within the twenty years reached the enormous total of 69,454,000. This series embodies the idea of supplying farmers with brief, inexpensive bulletins, written in clear, nontechnical language and filled with practical information. It took several years for the Farmers' Bulletins to gain extensive popularity, but since 1895, when Congress voted annual quotas for distribution by its Members, the growth of the series has been phenomenal.

During the past fiscal year 34 new numbers were added to the Farmers' Bulletin series and two earlier numbers were revised. Of these 1,295,000 copies were printed. Of the earlier issues 235 were reprinted, the number of copies issued being 6,460,000. The total copies of all new issues and reprints amounted to 7,755,000, an aggregate exceeding the total output of any previous year by more than 1,100,000 copies.

BUREAU OF STATISTICS.

During the year substantial progress has been made in strengthening the organization of the Bureau, perfecting its methods, extending its operations, and conducting special investigations.

GENERAL OUTLINE OF THE BUREAU'S WORK.

The principal lines of work carried on in the Bureau of Statistics may be stated as follows:

1. Gathering and digesting statistical data in regard to crop conditions, with monthly publication of results.
2. Gathering and digesting information in regard to domestic production of crops and farm animals, with annual publication of results.
3. Studies of the import and export trade of the United States in agricultural and forest products, with annual publication of results.
4. Studies of agricultural production in foreign countries and their export and import trade in such products, with compilations published annually.
5. Special studies and investigations of (*a*) agricultural production in the United States over long periods; (*b*) the foreign production of certain crops over long periods; (*c*) foreign markets for the agricultural surplus of the United States; (*d*) problems relating to the transportation of farm products within the United States and across the seas; and (*e*) various important phases of agricultural industry and rural life.

The work under the first two heads—the investigation of crop conditions during the year, and of annual production—is by far the most important, as it is through such work that this Department exercises an important influence on commerce by giving to the world advance information concerning its food supply. Without doubt the statistical data collected and published by this Department give stability to our markets, tend to prevent market manipulators from causing undue fluctuations in prices, and thereby aid the American farmer toward securing just and fair returns for the products of his labor and his invested capital. It should also be added that it is in these two fields of official endeavor that our statisticians secure the original data which form the basis of later and larger studies.

During the year the work of the Bureau was pushed vigorously and successfully along all the lines indicated above.

CROP-REPORTING SERVICE.

In its efforts to secure accurate first-hand information concerning crop conditions, acreage, and yields the Department has perfected an organization which practically covers the entire country four times. There is, first, a corps of township correspondents, at present numbering about 33,000. These report directly to the Bureau for their respective localities. Second, there is a corps of county correspondents who report directly to the Bureau, there being one in practically every one of the 2,800 agricultural counties of the United States. Each of these correspondents usually has two or more assistants located in different parts of the county who report to him. Third, there is a state statistical agent in each State, who has a large corps of local correspondents reporting to him. He not only tabulates these returns, but makes personal observations and reports monthly to the Bureau. Fourth, there is a corps of special agents, each an expert statistician, traveling over a definite area, making personal investigations and securing information from a variety of sources, and reporting directly to the Bureau. Here, then, we have what might be termed a quadruplication of original research which is practically continuous throughout the year. Besides the special agents and state agents who receive salaries, there are in all about 135,000 voluntary correspondents, mostly farmers, who serve the Department with no compensation other than a limited number of publications and a small supply of seeds. This number includes about 25,000 representative farmers who are called upon at the close of each crop season for a report based on results of their individual farming operations. In addition to the foregoing, there are special lists of cotton, rice, and tobacco correspondents from whom data relating to these crops are secured; and supplementary data regarding wheat and cotton yields are secured, respectively, from millers and cotton ginners.

The Bureau secures its original data mainly by sending out blank forms or "schedules" to be filled and returned by correspondents of the several classes. During the fiscal year 1909, 1,509,000 copies of these blanks were sent out. A greater percentage of these were filled out and returned than in any previous year. Of the county reports, 76 per cent were returned, as compared with 74 per cent in 1908. The percentage of schedules filled and returned by township correspondents in 1906 was only 48 per cent. By 1908 it had increased to 63 per cent, and during the last year it was 66½ per cent. This shows gratifying progress in perfecting the Bureau's organization and increasing interest and appreciation on the part of the farmers.

By the organization and methods just described this Department arrives at an estimate of the crop prospects at the end of each month with the accuracy and reliability of which it is believed no similar estimate made by private agencies can approach.

THE LIBRARY.

The demands on the Library by Department workers and other scientists engaged in agricultural research continue to increase. The charges recorded at the loan desk during the year numbered more than 30,000, and in continuance of the policy of cooperation about 400 books were loaned to scientists connected with the various agricultural colleges and experiment stations in the different States and in Canada.

Accessions during the year numbered 4,300, among them being many important reference books. Purchases are limited to subjects of special interest in connection with the work of the Department. Valuable publications have been received from all the States and from many foreign governments. Many of these publications probably are not to be found in any other library in this country. The total number of books and pamphlets on hand at the close of the fiscal year was 104,300.

An important work of the Library is the distribution of publications to foreign countries. The foreign mailing lists of the several Bureaus being in its charge, duplication in the sending out of publications is avoided; they are placed where they will be of most service, and useful material is secured in exchange.

OFFICE OF EXPERIMENT STATIONS.

RELATIONS WITH AGRICULTURAL EXPERIMENT STATIONS.

The agricultural experiment stations throughout the United States are increasing the extent and variety of their work, and are reaching the farmers more effectively than ever before. Through substations, demonstration fields, cooperative experiments, special railroad trains, farmers' excursions to the stations, exhibits of improved products, live stock, machinery, etc., at county, state, and national fairs, the practical results of experimental work are being brought home to multitudes of farmers in every State. Cooperation with this Department is being largely increased, and the inspection service of the stations is being broadened.

Special attention is now being given to the stricter differentiation of the work and publications of the stations as related to the extension departments which are being rapidly organized in the agricultural colleges. It is fortunate that extension work is growing apace, and it will be doubly so if the extension departments are so organized and manned as to relieve the stations of a great burden of routine work which they have been vainly trying to carry. Legislatures, governing boards, and the public generally will do well to draw a clearer line between experimental and demonstration work, and while they liberally support the new extension departments of the colleges, they should not forget the needs and requirements of the stations.

To aid our agricultural scientists in the Department and the colleges and stations in keeping thoroughly informed of the progress of agricultural science throughout the world, special efforts have been made during the year to bring the Experiment Station Record more closely up to date. Twenty volumes of the Record have now been completed. These contain reviews of 71,650 articles, gathered from all quarters of the globe. In this great literature the United States is represented by 3,055 publications of this Department and 7,780 bulletins and reports of the state experiment stations.

By far the greatest part of the work of all institutions for agricultural research consists in the gradual accumulation of data by which light is thrown on agricultural problems and their solution thus gradually brought about. This may be illustrated by brief reference to some of the lines of work in which our stations are now engaged.

In the feeding of animals the Missouri Station has conducted a remarkable series of experiments upon the use which steers make of their feed under different methods of feeding, and the Wisconsin Station is showing that, in their effect upon the animals, there are differences between feeding stuffs which are not shown by the composition and digestibility.

Success in growing alfalfa in the northeastern States is being gradually attained, and the experiment stations have developed methods by which this valuable forage plant can be grown in New York and the New England States.

Weed seeds in commercial feeding stuffs have been found to be an increasing source of contamination. Some by-products and mixed feeds have been found to contain from 5,000 to 80,000 weed seeds per pound. A large part of these pass into the manure without losing their vitality.

Great progress has been made in the use of miscible oils for spraying for scale and other insect pests on fruit trees. The crude and refined oils are likely to injure the trees; but after much experimenting the stations have devised a means of preparing a miscible oil which is effective and safe.

AGRICULTURAL COLLEGES AND SCHOOLS.

During the year the agricultural colleges have given instruction in agriculture to more students than in any previous year, and have also done more effective work along other lines. Several of the biennial state appropriations for these institutions have approached or passed the half-million mark, notably in Montana ($487,000), Pennsylvania ($526,000), and Kansas ($671,000). The growth of the agricultural colleges is also indicated by the number and character of college buildings completed during the year. Among the more important of these were the following agricultural buildings: Georgia, $100,000; Iowa, $400,000; Maine, $50,000; Michigan, $175,000; Missouri, $100,000; and Montana, $80,000. Wisconsin has completed a $75,000 live-stock pavilion, and California has started work on a $200,000 agricultural building. The third session of the Graduate School of Agriculture, held at Cornell University, had a larger attendance and was more generally successful than either previous session; graduate schools offering courses in agriculture were established in Illinois and Massachusetts; faculties and courses of study were reorganized on broader lines in Alabama, Arkansas, Georgia, Louisiana, Massachusetts, Oregon, Rhode Island, South Carolina, and Wisconsin; definite provision for training public school teachers of agriculture or for aiding them through extension departments or special publications is now made by agricultural colleges in twenty-seven States, and fully as many of these institutions are engaging actively in other forms of agricultural extension work. New agricultural colleges have been established in Hawaii and Porto Rico, and the former was opened early in 1909.

Secondary courses in agriculture have been started in connection with the agricultural colleges in Montana, Oregon, South Dakota, Texas, and Virgina; two district agricultural high schools have been provided for in Idaho, likewise four in Arkansas with a total appropriation of $160,000, two more in New York with a total appropriation of $100,000, and five in Oklahoma, two of which have been located and have received $20,000 each for buildings and $12,000 each for maintenance. Subsidies have been voted to encourage the teaching of agriculture and domestic science in public high schools as follows: In Texas, $32,000; in Minnesota, $25,000 for ten schools; in Virginia, $20,000 for ten schools; in Mississippi, $1,000 for one school in each county; and in Louisiana $500 to each school approved by the state board of education. In Massachusetts the Smith Agricultural School and Northampton School of Technology has been opened at Northampton and smaller agricultural high schools at Petersham and Montague.

The introduction of agriculture into the elementary schools has also been promoted actively. In this work the colleges have been particularly active through their summer schools and other teachers' courses and through the preparation of courses of study and school leaflets and the encouragement of boys' and girls' clubs. These clubs are coming to be very effective agencies for interesting young people in agriculture and home making and are now reported from twenty-nine States with a total membership of upward of 150,000. Agricultural college men have also been active in the preparation of textbooks and manuals for secondary and elementary schools. One secondary and six elementary texts were published during the year.

FARMERS' INSTITUTES AND AGRICULTURAL COLLEGE EXTENSION WORK.

Six years ago Congress made an appropriation of $5,000 to this Department to enable it to provide a special officer to investigate and report upon farmers' institutes and similar organizations in this and foreign countries. At that time the attendance upon the institutes in the United States was reported at 820,000. Now all of the States have institute organizations, and there were held last year 4,926 regular institutes consisting of 15,210 half-day sessions, with a total attendance of 2,196,568, and, including railroad specials, round-up institutes and other forms of institute activity, of almost three millions (2,906,699). This represents an increase in attendance at the regular institutes over the year 1903, when the Department first secured an appropriation for conducting investigations along institute lines, of more than 167 per cent, and if all forms of institute activity are included of about 270 per cent. The appropriations by the States for the support of these institutes for the last year amounted to $338,000.

Normal institutes for the instruction of farmers' institute teachers have now become a part of every well-organized institute system. Eight of these normal schools were reported during the year, with an attendance of 1,000 institute lecturers.

Fourteen States ran railroad specials and report an attendance of over 159,000. Numerous other railroad specials were conducted by state boards of agriculture and by the agricultural colleges, independent of the institute organizations. More than any other agency these specials have interested the managers of the transportation companies in the improvement of agriculture. The railroad companies now not only furnish trains to the institute directors free of charge, but they provide also board and lodging for the instruction force.

Movable schools of agriculture are fast becoming leading features in farmers' institute development, over 2,500 persons being registered as students in these schools during the year. The instruction is given by skilled teachers to classes of adults regularly organized, and the sessions continue from one to three weeks in a locality. Wherever they have been tried they have been found very satisfactory. The Department has had prepared model courses of study for use in such schools, and has in preparation additional courses, some of which it hopes to equip and put into operation as illustrations of the best methods of conducting them and as demonstrations of their practicability and value.

Special subject institutes are being introduced in many of the States. Where these are conducted the entire institute period is devoted to the treatment of a single subject, discussing it thoroughly in all of its features. This form of institute has been found to be much more valuable than an equal amount of time given to the superficial discussion of several topics. Over 17,000 persons were in attendance upon meetings of this character during the year.

Institutes especially intended for women are rapidly being organized. Twenty-one States held institutes of this character in 1908. The need for more definite instruction for country women in domestic and sanitary science and household art than is given in the ordinary institutes for men has brought about a great demand for institutes for women.

THE DEPARTMENT'S INSULAR AGRICULTURAL EXPERIMENT STATIONS.

In Alaska during the past season special efforts have been made to develop the station near Fairbanks, in the Tanana Valley. In order to equip and develop this it was found necessary to close the Copper Center Station temporarily, and the buildings and lands have been turned over to the Bureau of Education of the Department of the Interior for use until such time as this Department desires to resume work at that place. The investigations with cereals are being extended, and while, in 1908, 57 out of 65 varieties of grains fully matured at the Rampart Station, located 65° 30′ north latitude, the results this year were still more favorable, practically every variety of spring grain ripening its crop. Winter rye and winter wheat survived the rigors of the winter and were fully matured where the snow was not blown from the plats. Oats sown for hay produced a heavy crop of grain, and it can be confidently asserted that barley and oats can be successfully grown in the Yukon and Tanana valleys, so as not only to supply the needs of the grower, but also to yield a surplus for market. The selection and breeding work with cereals is being continued, and some forms have been bred that appear to be superior to the original varieties from which they were obtained. It is believed that within a few years varieties will be developed that are fully adapted to Alaskan conditions. The experiments at Fairbanks have not been in progress long enough to warrant definite statements regarding them, but the results thus far obtained have been quite favorable, and it is intended at this station to prove or disprove the possibility of profitable farming in that portion of Alaska. The Galloway cattle at the stock-breeding station on Kodiak Island wintered satisfactorily without any shelter other than that afforded by an open shed. During the summer they grazed on native grasses and throughout the winter were fed exclusively on hay and silage made from native grasses. A larger range for the stock has been fenced during the season just past. The horticultural investigations conducted at the different stations have fully demonstrated the possibility of producing an abundance of hardy vegetables of good quality. The special agent in charge reports the fruiting of more than a thousand of the strawberry plants produced by crossing the wild and cultivated varieties, and the fruit of some of the plants compared favorably in size and quality with the best of the cultivated varieties. It is believed that the hardiness of the native variety and the quality of the cultivated ones have been successfully blended in the new varieties.

The efforts of the Hawaii Station to diversify the agriculture of those islands are beginning to show results. The discovery of some of the difficulties attending the shipment of fresh fruit and means for their control has been followed by greatly increased shipments, particularly of pineapples. Methods for the propagation of citrus, mango, and avocado trees have been worked out, and with the investigations now in progress in orchard management it is believed that most of the obstacles that have prevented the increased production of tropical fruits will be removed. The rice investigations, which have been in progress for several years, have developed better and more prolific varieties and have made possible the devising of methods for the fertilization of the crop which more than double the yield of ordinary rice lands. Great interest is being taken in the experiments with cotton, especially with the Sea Island varieties, of which the station has several well-marked strains. Heavy yields of all the varieties have been obtained, and of some of the Sea Island strains the yield exceeds anything hitherto reported, while the quality of the fiber is most excellent, the fiber being in some cases very silky and more than 2 inches in length. It has been found possible to grow cotton either as an annual or as a perennial, and when it is grown as a perennial by pruning and cultivation the time of maturity of the bolls can be controlled. As a result of the station's experiments about 100 acres were planted to cotton this year and probably 1,000 acres will be planted in 1910, some of the areas formerly in cane being given up to this new crop. The station has devoted considerable time to a study of the causes of the yellowing of pineapple plants in the field, and it has been found chiefly due to the presence of large amounts of manganese in the soils. Experiments are now in progress to overcome the undesirable soil conditions. The rubber investigations have been highly satisfactory, and as a result of experimental tappings of 500 trees the most economical methods of tapping and coagulating the latex have been worked out. The experiments have shown the possibility of the profitable production of rubber from Ceara trees in Hawaii. There are now 1,500 acres or more of rubber trees planted in Hawaii, and the profitableness of the new industry seems to be assured.

On account of the primitive condition of agriculture in Porto Rico, much of the work of the station is devoted to demonstrations. Investigations are being carried on by the different departments of the station, however, and results of immediate benefit have been obtained. Especial attention is now being given to the production of citrus fruits. Wind-breaks for orchards are being extensively planted as a result of the station's demonstrations. The work with pineapples has practically revolutionized the former practices and has made possible the considerable expansion of that industry. Important studies on Porto Rican soils have been begun, looking toward the renovation of the soils that have become worn through continued cropping. A study has been made of the reason for the lack of fertility in certain soils and a cause determined, together with methods for its control. One of the chief causes for the so-called "tired" or "sick" soils was found to be of bacterial origin, which can be corrected by cultural and other methods. An important contribution of the station to the agriculture of the island has been the introduction of improved cane seedlings, and these are being planted as rapidly as the station can supply the demand. The highly valued coffees of Arabia, Java, and other countries have been introduced, and from the few fruits that have been borne it is evident that the peculiar flavors which characterize them have been retained. These are being propagated and distributed as rapidly as possible, in order to supply a kind of coffee better suited to American tastes. Considerable advance is being made in the improvement of the live stock of the island. The station has introduced several breeds of cattle, swine, and poultry, and is disposing of the surplus, but the supply is not at all equal to the demand. It has also introduced woolless sheep for mutton purposes, milch goats, Brahman cattle, and saddle-bred horses, all of which are being used in breeding experiments. An experiment has been successfully carried on in ensiling Para grass and cane tops, when they are plentiful, for feeding during the dry season. The station has introduced some Italian bees and established an apiary, the increase from which is in great demand. While the honey produced is a direct source of income, the presence of large numbers of bees will, it is thought, assist in better pollinating the coffee during the short period of its flowering, and thus contribute to the general prosperity of the island. The material equipment of the station has been greatly increased, and a new office and laboratory building provided by insular funds has been completed and equipped.

After a considerable delay negotiations were completed for a site on the island of Guam, and preliminary work was begun for the establishment of an agricultural experiment station. The work at this station for some time will of necessity be confined to the introduction of improved varieties of crops and animals and demonstration experiments. Agriculture in Guam is extremely primitive, and only by repeated object lessons will much advance be obtained. A considerable number of varieties of grains, fruits, forage plants, etc., have been introduced, and their adaptability is being determined.

NUTRITION INVESTIGATIONS.

A problem of special importance which is being studied in the course of the nutrition investigations of the Office of Experiment Stations is the ease of digestion of cheese made in different ways and cured for varying lengths of time, such data being needed to round out the extended series of investigations which have demonstrated the thorough digestion of cheese and its great value as an article of diet when used in quantity. Information will also be sought by means of experiments with the respiration calorimeter (which has now been reconstructed in Washington) regarding the comparative value for the body of olive oil, lard, butter, beef suet, and other table and culinary fats. Studies are also contemplated which will supply additional and much needed data regarding the value as food of fruits and nuts and products made from them. In all this work the respiration calorimeter is essential for measuring factors which can not be determined by any other means.

For several years studies were carried on of the food value of meat of different kinds and cuts prepared for the table in various ways, and much valuable information was provided as a result of this work. From the data at hand and the results of some special tests, a summary has been prepared regarding the use in the home of the cheaper cuts of meat, a question which is now of decided importance in economical household management.

The nutrition investigations of the Department have an intimate relation to the work of the experiment stations and the agricultural colleges. In response to a widespread demand from farmers and others, some of the experiment stations are studying problems which pertain to human food, while the agricultural colleges are conducting courses in home economics in which instruction concerning the nutritive value of different foods and ways of handling and cooking them are important features.

IRRIGATION INVESTIGATIONS.

During the year the activity in the construction of irrigation works has not lessened, but, if anything, has increased. New works are built at a constantly increasing cost, requiring more capital in the hands of settlers and the growing of more valuable crops, thus limiting the number of people from whom settlers may be drawn, and restricting also the range of crops which can be grown at a profit, making the securing of settlers more difficult and decreasing their chances for success. For these reasons there is great danger of overbuilding and a recurrence of the experience of twenty years ago, when canals were built so far in advance of settlement that the lands under them are not all reclaimed yet. With the present cost of water rights and the large expense of preparing arid lands for the growing of crops under irrigation, settlers can not afford to spend either time or money in working out for themselves the best methods of preparing their land for irrigation, of building their ditches and other structures, and of applying water to their crops. For this reason the irrigation investigations carried on by this Department have for the past few years been devoted very largely to collecting information as to the best methods of performing all the agricultural operations connected with irrigation, and supplying this information to settlers, principally in the form of practical bulletins, but also by demonstrations on farms maintained in cooperation with several of the state experiment stations and by personal advice and public lectures.

There are, however, sections where the demand is not for more settlers but for more water. The available water supply has been utilized, and agricultural extension depends upon a more economical use of this supply. Eventually this will be the prevailing condition throughout the arid region, since under the most economical use only a small part of the arable land can be irrigated. On the basis of studies made by the Department it has been estimated that the water at present turned into the main canals in the arid region can be made to serve approximately double the area now irrigated with it, since not much more than half the water entering the canals reaches the land, and there are large losses in application. The prevention of these losses in transmission and in application to fields is the most promising source of an increased water supply. Much attention has, therefore, been devoted to determining how much water is required to grow crops under different conditions, how much is lost, the source of loss, and the means of preventing losses.

Settlement on the semiarid plains has continued during the past year, with little diminution, but each added year of experience demonstrates more fully the value of the plan advocated by this Department of irrigating small areas in connection with the farming of larger areas without irrigation as an insurance against total crop failure and to provide a home-grown food supply. The farms established several years ago for the purpose of determining and demonstrating the value of this practice and the methods to be employed have been maintained during the year. In addition, information as to the use of windmills for pumping water for irrigation on the plains has been collected and prepared for publication, and accurate tests of mills of different types have been made, in order to supply information as to their most economical use and to work out improvements in their construction. These tests promise to bring about improvements by which a much larger part of the power of the wind may be utilized, making it a most valuable source of power.

The recent years of drought in the East and the spread of intensive farming in that section have caused eastern farmers to realize that they can not afford to depend entirely upon rainfall for the maturing of their crops, and they are calling upon this Department for information as to methods of securing and utilizing water supplies for irrigation. In response to this demand, an expert has been detailed to the eastern field and is devoting his time to a study of eastern conditions and the adaptation of western irrigation methods to these conditions.

DRAINAGE INVESTIGATIONS.

DRAINAGE IN THE IRRIGATED REGION.

Among the most important investigations in drainage are those which are conducted upon irrigated lands. For years it has been known that some irrigated fields easily become swamps, while the productiveness of others is ruined by the accumulation of injurious alkali. The lands which are most easily irrigated by water from the mountain streams, and which are surprisingly productive when first reclaimed from a desert condition, not infrequently become noisome bogs or alkaline wastes after a few years of cultivation under copious irrigation. This is true of a portion of every irrigated valley in the West. Utah contains not less than 150,000 acres of such land; Colorado, 75,000; California, 100,000; Nevada, 250,000; Wyoming, 50,000; Montana, 60,000; Idaho, 40,000, all having been once cultivated and still having valuable water rights. These are conservative estimates, showing the gravity of the situation, and when considered from the point of the owners particularly emphasize the importance of using preventive as well as curative measures in the treatment of saturated lands which are under irrigation.

OVERIRRIGATION NOT ALONE RESPONSIBLE.

While an injudicious use of water and a faulty distribution system hasten the formation of seeped land, it is acknowledged by good irrigators that in ordinary farming practice there is a waste of water which can not well be avoided. Where there is not good drainage, the surplus water accumulates until evil results appear.

Experiments and examinations have brought out some useful as well as encouraging facts about seeped lands and the methods of restoring them to productiveness. The changing of a productive soil into a bog or alkali waste is a process hidden from view, and, like an insidious disease, is often not discovered until disastrous results are manifest. The lower lands begin to fill with water at varying depths from the surface, the level rising gradually until it reaches the surface. The movement of the soil water is modified by hardpan gravel and shale formations, as well as by other less pronounced physical characteristics. The effects manifest themselves by the utter failure of crops in spots, which enlarge yearly until the entire field becomes barren and often so soft that it can not be crossed by teams. The injury extends from farm to farm until the larger part of an irrigated valley becomes covered with salt grass, alkali weeds, or, in many instances, becomes a barren alkali waste.

METHODS OF DRAINAGE.

While such lands in the several irrigated districts show great differences in condition and in the facility with which they may be reclaimed, as well as in relative value after restoration to a productive condition, the following methods have in most instances proved effective.

One drain should be placed along the upper edge of the wet land approximately across the surface slope and sufficiently deep to intercept the underflow from the higher land. Frequently this depth must be from 5 to 7 feet. The drain may be a large open ditch, a covered lumber-box drain, or a large pipe, according as may be expedient in such locality. Where the land lies in a series of benches, drains should parallel the upper border of each bench.

A few drains are usually required in the lower parts of the fields to remove surplus water which is supplied directly by irrigation or rainfall. These should be located in the depression, but should not be constructed until the intercepting drains have cut off the supply from outside sources.

Drainage wells have proven effective where gravel formations are found bordering the saturated lands. When placed at well-selected intervals and sunk to a depth of 8 to 10 feet they collect free water which, rising in the wells, is removed by tap drains placed at convenient depths and discharging into some adequate outlet.

These measures, simple in principle and easily described, are sometimes difficult to carry out. A thorough examination of the under strata of the soil, by means of auger and testing rod, is a necessary preliminary to the location of any and all drains. Deep drains only are efficient. While subsequent treatment by means of washing and special crops is required to restore lands which have become highly charged with alkali, drainage alone, with some special irrigation and judicious cultivation, will quite frequently restore the land to its original productiveness in one or two years. Where alkaline conditions do not prevail the restoration is marked and immediate.

COST OF DRAINING IRRIGATED LANDS.

By means of the investigations of the Department carried on in cooperation with landowners in several States, the practicability of draining lands of this class at a reasonable cost has been shown and is now admitted where experimental work has been done. It is estimated that there are not less than 725,000 acres of irrigated land which has become seeped and is susceptible of drainage. The cost of draining the land will be $15 to $25 per acre. It is located in the older irrigated centers and is furnished with paid-up water rights, and will easily be worth $100 an acre when reclaimed. Basing estimates on this price and on a cost of draining of $20, the net gain in value brought about by drainage would amount to $58,000,000. In view of these conditions and facts, farmers who own lands of this class can better afford to reclaim than to abandon them, or, as is frequently done with the lands less seriously injured with water, to use them for salt-grass pastures.

OFFICE OF PUBLIC ROADS.

The Office of Public Roads has continued the work of aiding road improvement by studies, experiments, and object lessons. Proper construction and maintenance of public highways engages public and official attention to a great extent, and the Office of Public Roads has proven its usefulness to the general public more emphatically than ever before. The adoption of state aid in the construction of public roads by more than half the States and the consideration of the question by the remainder, together with large bond issues by many counties, are indexes of the general interest being shown in the work, and have occasioned a great demand upon the Office for advice and assistance. These have been given to the fullest extent compatible with the resources of the Office, and have brought about more active cooperation and larger material results than ever before.

OBJECT-LESSON ROADS.

During the past year especial attention has been given to object-lesson work. Of the total appropriation of $87,390 made for the Office, $16,916.79 was expended in carrying out demonstrations on 69 sections of road, with a total surface area of 661,992 square yards, as against $17,908.25, expended on 31 sections, with a total of 223,208 square yards, during the preceding year. These operations covered 12 macadam, 26 sand-clay, 7 gravel, 10 earth, 1 shell, and 15 experimental roads. The experimental roads consisted of 8 sand-clay, 1 burnt clay, and 6 roads in which oil or asphaltic products entered as binder. The purpose of these object-lesson roads was to give elementary instruction to local road builders and to demonstrate the possibilities of road improvement. They were built under cooperative arrangements by which the local authorities paid all expenses of machinery, labor, tools, and materials, the Government providing for the engineering work. So effective has been this phase of the educational work of the Office that the number of square yards constructed has grown from 79,203 in 1905 to 661,992 in 1909.

EXPERIMENTAL WORK.

Second in importance only to object-lesson work is the experimental work of the Office. The most important problem considered has been that of preventing the destructive action of automobile traffic on costly macadam roads. In working out this problem experiments have been made to secure satisfactory binders and dust preventives within reasonable cost. Excellent results have been attained in the use of asphalt, tar, and other bituminous binders, waste from sugar refineries and wood-pulp mills, and other by-products. It was largely to consider this question that the greatest road convention ever held was convened at Paris, France, in which 29 countries participated, the Director of the Office of Public Roads being chairman of the commission of three representing the United States.

Especial attention has been given to experiments with blast-furnace slag—alone and in combination with other materials—in the construction of roads, to find a way to utilize the large quantities of this waste material available.

The sand-clay road has been found so satisfactory in the South that it has been introduced into several of the Western States, notably Iowa, Kansas, and Nebraska. The construction of such roads is expected to prove of great value in the trans-Mississippi States.

During the year 185 lectures were given by representatives of the Office of Public Roads in 29 States, as against 200 lectures the preceding year. This decrease was not due to any lack of demand for this character of assistance, but rather to the necessity of withdrawing engineers from the lecture platform to supervise object-lesson work. These lectures were not given for entertainment, but to educate those who have to do with the construction of roads and the administration of highway affairs.

The advisory work of the Office, aside from object-lessons and lectures, comprises the introduction of model systems and special advice and inspection. The work with model systems involves assignments under which an engineer of the Office examines the entire road system of a county, its road materials, and other phases of the public-road situation, and makes a detailed report, with advice as to best methods and materials. Five counties have been so assisted during the past year. Assignments for short periods have been made for aiding in the solution of local problems in 142 cases.

An attractive and instructive exhibit was made at the Alaska-Yukon-Pacific Exposition at Seattle by the Office, the details of which were described in a small handbook.

ENGINEER STUDENTS.

The demand for skilled road engineers shows no abatement. The success attending the instructions given in the Office of Public Roads has led to an investigation of the status of highway engineering in various technical schools and colleges. It was found that greater attention is given to this branch of engineering than heretofore. The policy of appointing engineer students in the Office of Public Roads has been continued with good results. Under this policy a limited number of young men with engineering training are appointed at small salaries and, after a course of thorough instruction in highway work, are advanced to the position of assistant engineer and given practical work in the field. The success of the plan is demonstrated in the increased drafts on this corps for state and municipal work.

I have endeavored in the foregoing report to call attention to the work of the Department during the past year in all its Bureaus, Offices, and Divisions. The new responsibilities laid upon us have been met with fidelity and with what ability we possess. We are helping the farmers of all sections of the country and the isles of the sea, and results are becoming evident. The soil is responding to better methods and more suitable plants, the farm income is increasing, farm education is making the rural home more attractive, each locality is becoming more useful to the others, each specialty more necessary to the others. Abundance contributes to happiness—people of the several States are learning to know each other better and love each other more.

Respectfully submitted.

James Wilson,
Secretary.

Washington, D. C.,
November 20, 1909.

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